

VII. *The British Species of Andrena and Nomada.* By  
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PLATES XI—XV

THE species of the genus *Andrena* and its parasites of the genus *Nomada* have perhaps been more sought after and collected than any other of our Aculeate Hymenoptera. This is probably due to the fact that in our limited fauna they present a good appearance in a collection, few being of small size and many of considerable beauty, while at the same time hardly any places are so poor as not to possess some local and interesting species. *Andrena* is a genus of enormous extent, our sixty-one species being a small fraction of those that exist, or, indeed, of those that have been already collected. Unfortunately, no one has yet been found to classify the species as a whole, and no satisfactory grouping even of the European forms has yet been achieved.

The various arrangements that have been proposed for our British species all leave something to be desired. Those adopted by F. Smith and Shuckard are quite impossible and unnatural, being based on superficial appearances. The classification used in the works of Edward Saunders was a vast improvement on these, especially that in his last book. Schmiedeknecht's arrangement in the "*Apidae Europaeae*" is often unsatisfactory. But before considering in detail the arrangement in groups of our British species, some notes on the habits of the species and their parasites may be given. Smith, Saunders and Shuckard have all described these to some extent. All these collectors had constant access to some of the finest collecting grounds that are to be found in the South of England, and consequently there is a tendency, I think, in their writings to consider species that are really quite local to be of more general distribution than they actually are. As a beginner it was my lot to collect in a district where a sandy soil—so attractive to most Aculeata—was wanting, and in consequence it was years before I met with living specimens of

many species, which in a more favourable district would be considered very commonplace.

The habit of forming "colonies," that is for great numbers of individuals of a species to form their burrows side by side, often so close together as almost to touch one another, is very marked in some species of *Andrena*, while others rarely or never do so. Thus one may sometimes see hundreds of burrows of such species as *A. humilis*\* or *A. sericea* (*albicus*) in a square yard or two of surface, while species like *A. trimmerana*, *nitida*, *albicans* and others rarely or never form these compact colonies. Some species, e.g., *A. cineraria*, sometimes form dense colonies, but at other times their burrows are scattered singly or two or three together over a large acreage of land. In such cases it is probable that in the one instance the soil and other conditions are pretty much the same over the whole area occupied, and in the other that a limited spot affords conditions pre-eminently favourable, as compared with the surrounding country. I suspect the colonising is due sometimes to a natural sociability of the species or a reluctance to depart from their immediate birthplace, for we have seen a colony with few individuals—probably it had originally been started by a single female—increase in size and become permanently a large one, subject only to increase or decrease as the seasons were favourable or otherwise. Some of these colonies persist for many years. V. R. Perkins, in his list of the bees of Wotton-under-Edge, Gloucestershire, records the discovery of a colony of *A. humilis* in 1876, from which he collected the species again in 1882, 1887 and 1891. I myself collected from this colony in 1886, 1887 and 1890, and observed it to be still present in 1907 and 1914. As no other colony of this bee has ever been observed in the district, we may assume that this one has maintained its hold for nearly forty years at least, and might conceivably have existed for centuries. Some colonies are of such vast extent as to produce almost incredible numbers of individuals. Thus those of such species as *A. humilis* and *A. sericea* sometimes extend in favourable situations, with breaks perhaps at intervals, for hundreds of yards. Smith remarks of the first named that in a pathway at Hawley Green,

\* The changes in nomenclature adopted in this paper will be found on p. 269, the names used in recent British works and catalogues being added in brackets.

Hants, there was a colony "so numerous that their flight as they skim over the surface of the ground, produces a loud humming noise." I have noticed similar colonies of this species myself, and have recorded the same of *A. wilkella*. Other species that do not form those huge dense colonies are sometimes equally successful in the production of individuals, and I suppose every one must have noted the incalculable numbers of *A. albicans* that may be seen flying along a single hedgerow, or of mixed common species flying round some attractive flowering tree or bush. At times local or even rare species may be observed in numbers not at all inferior to those of the commonest. Indeed, many of the most local species, where they do occur, are amongst the most plentiful. In Devonshire we have seen at times the males of *A. synadelpha* (*ambigua*), *fucata*, *fulvago*, *bimaculata* and others so numerous on the wing that a number could be taken at a single stroke of the net. One most noticeable feature about the species of *Andrena* is the frequent apparent disparity of the sexes in the number of individuals observed, when both ♂ and ♀ are fully out. Thus in the case of *A. synadelpha* above mentioned, if one stands for an hour or two by a hedgerow that I have in mind, up and down which the males are coursing in great numbers, it is most probable that not more than one or two females will be seen. These burrow in a scattered fashion over the adjoining heath, and do not flock, like the males, to the hedge that borders it, so that, unless one happens to be found sunning itself on a leaf or entering a burrow, it is quite possible that not even a single example of this sex will be met with. Nor have I ever found them on flowers in the immediate vicinity, and they must go elsewhere to find these. Mr. Morice once lent me a long series of beautifully fresh females of this species which he found all together (and many males in their company) on the flowers of *Erysimum alliaria*, but this plant does not grow in the locality where I find the males so plentifully. If, when a species first appears, the weather continues fine and hot, the males generally last for a very short time. This is especially the case with many of the less common species, and it is very annoying to find a plentiful supply of females of a desirable species, either on flowers or at their burrows, and not to be able to secure a single specimen, or only a few old and worn specimens, of the other sex. The males invariably appear before the females, either by a day or two or

still more in advance, and, as has been said, last for a much shorter period. Isolated cases of a female captured before a male has been seen are not to be considered as anything but abnormal exceptions, the aggregate of the latter sex always preceding the other. Sandy, gravelly or light soils are absolute requirements of some species, and they need not be looked for where these do not occur. Rich meadowland is greatly inferior as a collecting ground to sandy heaths, waste places and coast land. Certain species, however, such as *A. albicans*, *nigroaenea* and *wilkella* seem to flourish equally in almost all situations in the South of England.

The welfare of our wild bees and wasps is probably more dependent on weather conditions than is that of any other group of insects. Most of their species never venture from their burrows unless the sun is bright, though some will do so on sultry days, even though the sky is overcast. In early spring some species of *Andrena* are active enough, even though the temperature is low, provided that the sun is bright. A thoroughly wet and cold season is very disastrous. Of those that I have spent in England since I began to collect our Aculeates, the year 1888 was the most remarkable. The preceding season was a favourable one in North Wiltshire, and during the autumn the species of such genera as *Halictus* and *Sphcodes* had in all probability reached their maximum abundance. The hibernated females of these, of course, appeared in the following spring, but the new generation was almost wanting. Only a few males of the most abundant species began to appear in August, about a month late—and four of the commonest *Sphcodes* could not be found at all. *Andrena nigroaenea* was still endeavouring to collect pollen at the end of August, and *A. wilkella* far into September. The first males of *Halictus nitidiusculus* and *H. xanthopus* appeared on Sept. 20th, while on Oct. 5th nearly every garden flower was cut down by the severe frosts. A colony of the last named, thousands strong, was entirely destroyed and never reappeared. Sudden storms, especially hail-storms, that occur when the season is well advanced are very disastrous. Being aware of a spot where *A. proxima* occurred, I started one day at the beginning of June in bright sunshine to the locality. On reaching the place males were at once noticed flying about the bushes, and females gathering pollen from the flowers of a white Umbellifer. Just then it clouded over and hail began to fall. A few of the bees were picked up in

a torpid condition from the herbage, but the bad weather continued, and further visits on the fine days following failed to yield a single specimen. In the early spring bees seem to be aware of these coming changes of weather, and vanish as if by magic when the sun disappears. That rarer species manage to survive such disastrous climatic changes is very probably due to the fact that in some species, and perhaps in all, a percentage of individuals do not emerge in the normal period, but remain over as larvae, to become developed in the following season. This occurs not only in cold climates, but also in the tropics, and must be of great advantage for the continuance of a species. It has already been mentioned that some species of *Andrena* are not constant in their habits of forming compact colonies, nor are they so with regard to their choice of a situation for these colonies. For instance, I have found the fine *A. hattorfiana* forming a compact colony in a hard-trodden pathway, while hard by others were burrowing singly in places where the ground was well covered with vegetation. Again, when we consider the plants from which they collect the pollen and honey for their nests and procure the latter for their food, we find a great diversity of plants chosen by the individuals of some species. Also a flower that is much visited in one locality appears to be nearly or quite neglected in another. In Suffolk the summer brood of *A. bimaculata* was found on one occasion in great numbers on the flowers of *Senecio* on the breck-sands, whereas in Devonshire I have been through acres covered with these flowers where, although *bimaculata* was numerous, not one was observed to visit them. Smith says that *Nomada* \* *roberjeotiana* is to be sought for on the flowers of *Senecio*, but in Devonshire this bee visits almost exclusively the *Potentilla*, even though ragwort abounds in the same locality, and Mr. Morice informs me that he has only taken it on this flower. Very few of our *Andrenas* are constant to a single or one or two species of plants, but there are many that have a marked predilection for one or two. *A. florea* is, as is well known, peculiarly attached to the bryony, *cingulata* to the speedwell (*Veronica*), *humilis* and *fulvago* to *Hieracium*, *ceyii* and *hattorfiana* to the scabious. Some flowers are extremely attractive to a considerable number of species, chief amongst which are the catkins of *Salix*, together with the flowers

\* = *tormentillae*, Alfk.

of dandelions and other yellow composites, blackthorn, the white-flowered Umbelliferae and the bramble. Other flowers will be mentioned in connection with the different species.

The pairing of the sexes of *Andrena* is often noticed, and the vast numbers of males that one sees coursing up and down hedgerows and round sunny bushes are in reality searching for the females. When one of these alights, a collection of males is generally quickly attracted to the particular spot. In many cases these males will fly around, often within a few inches of the female apparently without seeing her, and it would seem as if sight played but a small part in the matter. Sometimes, however, she is perceived and pounced upon almost immediately. With species that form compact colonies there are often large numbers of males hovering about the burrows ready to seize the female as she leaves or returns to the nest. The females of some species seem to put themselves in the brightest sunshine on some broad leaf and in the most conspicuous position with the object of pairing, but others I have observed to settle on a branch or dead leaf, where had they not been seen to alight, they would not have been noticed at all. Probably pairing sometimes takes place in the burrows, for one evening in March I dug out a number of males and females of *A. apicata*, and although it was almost dark, it was possible to see that in several cases pairing was effected at once, when the sexes were placed together in glass-topped boxes. Pairing of individuals of distinct but closely allied species must be very rare, as I have never seen a case, though I have spent much time in watching the pairings of *A. wilkella*, *afzeiella* and *similis*, where these all occurred in company, and similarly with the equally closely allied species of the *trimmerana* group and the small bees of the *minutula* group. Nor have I ever seen a specimen that I should consider likely to be a hybrid. Saunders has suggested that *A. praetexta* of Smith might be a cross between *carbonaria* and *bimaculata*, but it seems to me to be merely a variety of the former, comparable with the var. *consimilis* of *A. nitida*.

Variation in the colour of the pubescence of *Andrena* is considerable in some species, especially in the substitution of brown or yellow hairs for black or vice versa, while in a few cases white and black become interchanged. Of course, changes due to fading from exposure to weather are not to be reckoned as variation. Few of these variations

have received names, excepting where the change of colour is due to seasonal dimorphism, and in these cases the names were given under the supposition that the two forms were distinct species. Such cases are *A. bimaculata* and *decorata*, *parvula* and *minutula* and others. The supposed species *A. mixta* Schenck is, I have satisfied myself, a variety of *A. varians* ♀, in which white hairs replace the black ones on the abdomen, face, and on other parts. More or less intermediate conditions are sometimes found, and a similar kind of variation, but less extreme, is found in the female of the allied species *A. synadelpha*. In neither case are there two forms of male known. All the few species of *Andrena* which have the integument ornamented with red are variable in a high degree, excepting only *A. cingulata*. All have melanic forms. Smith was of the opinion, that in the case of *A. hattorfiana* \* the red forms were produced in hot summers, but I do not think that this will prove to be a complete explanation. In my observations of this species in Devonshire only once have I seen a red-bodied example, though I have observed the bee in at least two summers of extraordinary heat and dryness, but this specimen of the red variety did not occur in either of the dry years. It is remarkable that in South Devonshire no red-marked varieties of either brood of *A. bimaculata*, nor any conspicuously red-bodied ones of *A. marginata* have ever occurred to me, though in the more eastern counties such are common, and those of the latter species are plentiful even in the neighbouring county of Dorset.

The dimorphic forms of first and second broods of the double-brooded species are in some cases of very great interest, and those which are in any way remarkable, and some even of those which are not so, have varietal names. In most cases the difference in structure or appearance between the spring and summer broods is far more marked in the ♂ sex. Saunders suggested that this dimorphism was produced by the different food (pollen of quite distinct species of plants) supplied to the larvae of each brood; but there is little reason to suppose that this is the cause of the dimorphism, for we see no such variation in the individuals of a single-brooded species, which must often be produced from

\* Mr. Morice informs me that in Mediterranean localities both sexes are almost invariably of the red variety. I have a long series from Germany with the males of the dark, the females of the red form.

larvae fed on food quite as different, as that supplied to each generation of the double-brooded species. *Andrena spinigera* is the most interesting of all these forms, since its second brood undergoes such marked changes in structure as to become very similar to the single-brooded *A. trimmerana* (Auct. nec K.), whereas the ♂ of its first brood (*i.e.* typical *spinigera*) is quite distinct structurally.

It is most interesting to notice the difference between closely allied species with regard to the production of a single or of two broods a year. Thus *A. tibialis*, one of the earliest spring bees, is always single-brooded, while its very close congener, *bimaculata*, is double-brooded. In this case the spring brood of the latter is contemporaneous with the one brood of the former. Of the very closely allied species *A. wilkella* and *ovatula* the former is single, the latter double brooded; but the first brood of the *ovatula* is, as a rule, decidedly earlier in appearance than the one brood of the other. Many of our earliest spring bees, which frequently appear in March, if the weather be at all warm, *e.g.*, *A. praecox*, *apicata*, *clarkella* and *albicans*, never produce a second brood, while others like *gwynana*, *bimaculata*, *spinigera*, *dorsata* and *parvula* do so regularly in the south, and when they are parasitised by *Nomada*, the parasite also is either regularly or occasionally double-brooded. In Northern Europe species which with us, even in the extreme south of England, are invariably single-brooded produce a second brood in summer, the first brood often appearing earlier than our one brood of the same species. Most notable of these are *A. sericea* and *argentata*, which appear in April, the former even in March, with a second brood in June, while it is also said to have even a third brood! A few of our species, *e.g.*, the small bees *A. saundersella* (*nana* E. S.) and *subopaca*, under exceptional conditions produce a partial second brood in August.

Some species of *Andrena*, *e.g.*, *carbonaria*, which have always an abundant second brood in the south, are generally single-brooded as one goes further north. Generally the specimens of first and second broods are easily distinguished in the majority of specimens, as is the case with *A. eximia*, *spinigera*, *gwynana*, *parvula* and others, but nearly always, in the ♀ sex at least, there will be found examples of either brood which cannot be distinguished at all or only with the greatest difficulty or uncertainty. We have at present no accurate information as to the actual life-history of any of

these bees, and it is quite possible that not all the individuals that one sees in the summer of a double-brooded species are really the offspring of a spring parent; for it may be that some of the offspring of the summer brood do not emerge till the following summer, and likewise that some of the spring brood have also taken a complete year before they have emerged. The somewhat perplexing aberrations one finds in these dimorphic species may possibly be due to such variations in the time occupied in development. In any case these double-brooded species are of the greatest interest, and so far they have been at the best very superficially studied. Some thirty years ago Edward Saunders intended to study them specially and publish his observations, but unfortunately he did not (so far as I am aware) carry out his intention. One other point which must be considered in connection with the spring *Andrenas*, which produce only a single brood, is the fact that in many cases, though there is no second emergence, the fully developed bee has left the pupa the same year that the egg was laid by the parent, and possibly even before the end of the summer. Consequently, the difference in the actual period of development between some of the single-brooded species we capture in the spring and the examples of other species, which are the offspring of a second brood of the preceding year, is not nearly so great as may have been imagined, but the conditions of temperature, etc., may be different and of importance. We know from Smith's observations that in the case of some bees, such as *Anthophora*, some individuals pass the winter as larvae, and pupate and produce mature bees in the following year, while others are already fully mature on the approach of winter, and, in fact, are occasionally dug up in that condition during the winter months. In the case of *Anthophora* this does not appear to lead to any noticeable variation. When we find examples of either brood of such a species as *A. dorsata* exactly resembling one another, while others have quite differently coloured legs, at present we do not know whether these different varieties have really taken very different periods of time for their development, a few months in one case and many months in the other, or whether those which are alike may or may not have taken the same period to become mature.

Of other variations one may mention that in which either the scopae or the anal fimbria or one of these, instead of

being dark or fuscous, becomes yellow or golden. Such are the var. *consimilis* Sm. of *A. nitida* and the var. *praetexta* of *A. carbonaria*, while among species that have a yellow scopa but normally a more or less fuscous fimbria there is a form of *A. tarsata*, in which the latter is a bright pale golden colour, and similar forms of *A. ovatula* also occur. In some species, e.g., *A. fucata*, the scopa may become quite pale without the fimbria being affected. The entire replacement of black hairs by white in *varians* var. *mixta* has already been mentioned, and the change from white hairs on the face to fuscous or blackish ones occurs in *A. nitida* var. *baltica*, common in Devonshire, and also in some specimens of *angustior* and others. Hermaphrodites of *A. flavipes* (*fulvicrus*), *bimaculata*, *dorsata* and *albicans* have been described by myself, and one of *A. nitida* by Smith.

Extraordinary variation in size is a remarkable feature of the males of many *Andrenas*, but in the females this is much less marked and of a different nature. In the latter sex there is usually a fairly average size in the largest specimens, while quite abnormally small, or starved ones, are found occasionally. In the males, on the contrary, whereas there is great general variability in the size, in many species gigantic examples are occasionally met with. This phenomenon is not at all uncommon, and there is nothing like it in the ♀ sex. Where the species are naturally large-headed, these giant specimens have a most striking and even formidable appearance. *A. bucephala*, *spinigera*, *trimmerana*, *fulva*, *synadelpha*, *fucata*, *denticulata* and others are conspicuous examples, but even in small species such as *chrysoceles* and minute ones like *minutula* one meets with individuals grossly oversized and sufficiently conspicuous amongst the normal.

Most, if not all, species of *Andrena* emit, when handled, a very distinct odour, and this is sometimes the case with both sexes. Kirby in his wonderful old book refers to this under several species. Thus of *Melitta pilipes*, he says: "*Allium spirat recens insectum.*" *A. gwynana* and *fulvicrus* are also said to smell of garlic. But *parvula* "*moscham spirat*" and *afzeiella* "*suavem spargit odorem.*" To myself the majority of species are mildly unpleasant, e. g., *A. albicans*, but some, if not actually pleasant, are certainly less unpleasant than others. *A. denticulata* emits an odour unlike that of such other *Andrenas* as I have examined in this respect. Mr. A. H. Hamm suggested

that the odour resembled that of burnt sugar, and this is perhaps as near a comparison as can be made.

Some of the bees of this genus feign death when alarmed, and may be seen lying on their backs on the ground or at the bottom of the net after capture with their limbs closely appressed to the body. This condition is assumed much more readily by some species than others. Some of the small species of the *minutula* group when the net is placed over them will often fall at once to the ground, and remain motionless amongst the grass roots till one's patience is exhausted in waiting for them to fly up. Some are much more willing to feign death when the sun disappears than when it is shining hotly, and some are able, like insects of other Orders, to slip along on their backs without the use of their legs, which remain appressed to the body. Species of the *wilkella* group, *A. chrysoceles*, *A. albicans* notably, and probably many others feign death, and will remain quiescent for a considerable time at the roots of herbage, no doubt until they consider the danger is past.

*Andrena* has numerous natural enemies, the bees of the genus *Nomada* and the remarkable Strepsipterous *Stylops* being of special interest. A few species are also attacked by members of the genus *Sphecodes*—most of which are, however, parasites of *Halictus*—and by the conspicuous and beautiful flies of the genus *Bombylius*.\* Some of the Conopidae also appear to be attached to *Andrena*, and they may be noticed flying at and striking against the bees as they fly around hedges or bushes, and even pursuing them for some distance. We have seen one species follow a laden ♀ of *A. nitida* right to its burrow and cling to it there. One may suppose that this proceeding is for the purpose of oviposition, so that the larva of the fly may be carried into the bees' burrow, but I have no information as to the actual deposition of an egg,

\* Chapman observed the oviposition of *Bombylius major* at the burrows of *Andrena labialis*, and, as mentioned hereafter, I have seen the same fly at pure colonies of *A. flavipes*, but it is not at all confined to these two species. On April 3, 1919, a dense colony of *A. c'arkella* was found with one or two empty pupa cases of *Bombylius minor* in the opening of nearly every burrow, and some of the flies, recently emerged, were sunning themselves on the bare earth in which the colony was placed. No doubt the formidable armature of curved spines on the head of the pupa beneath serves to enable it to reach the mouth of the bees' burrow, before the fly emerges.

when the insects come into contact. The burrows of colonies of *Andrena* are ravaged by *Forficula*, which frequently raise their young in them, and various Carabid beetles and the Myriapod *Lithobius* are numerous in the same situation.

In the case of *Nomada*, the different species are all mentioned hereafter in connection with those of *Andrena*, which they parasitise. It is possible that some have a rather wider range of hosts than I have allowed. Of one only, *N. flavopicta* K. (*jacobaeae* Auct. plur.), the host appears a little doubtful. Smith records it as having once been seen to enter the burrow of the second brood of *A. flavipes* (*fulvicrus*), and this may be its host. It has, however, occurred in some localities, where this *Andrena* either does not occur at all or, at any rate, has been overlooked, and should there have been some mistake on Smith's part, I suggest that it is attached to members of the group of *A. nigriceps*, one or other of which I have always found present in its localities. Two of our species are quite peculiar in their habits, *N. sexfasciata* breeding in colonies of *Eucera longicornis* and *N. furva* in those of *Halictus nitidiusculus*. The latter has been said also to be attached to *H. morio*, but I myself have never found this to be the case, though I have carefully investigated the matter in such distant localities as Oxford, Monmouth and Devon. *H. morio* is abundant in all these places, but the *Nomada* in my own experience either attacked pure colonies of *nitidiusculus*, or, if *morio* occurred in the same bank, was only obtained from the burrows of the former. In Devon it is sometimes found in mixed colonies of *H. nitidiusculus* and *minutus*,\* and in this case, owing to the great similarity of these two species, I could not be sure whether one or both were attacked. Smith says that this minute species was obtained from the cells of *Colletes daviesana*, but this, of course, does not necessarily mean that it is parasitic on that bee. Halicti, like other bees, sometimes enter burrows made by other species and form their nests therein, just as *Andrenas* enter rabbit, rat, and mice burrows. Similarly, Smith records finding *N. marshamella* in the cell of *Eucera*, this no doubt having

\* Since the remarks above were written this little *Nomada* has been obtained before the time of emergence from burrows of *H. minutus*, and, of course, it may well be parasitic on *H. morio*, but positive evidence of this is required.

been utilised previously by *Andrena*. The same author records several of our species of *Nomada* as parasites on various larger *Halictus*, and one, *N. fabriciana*, as being the peculiar parasite of *Panurgus banksianus*. Shuckard corroborates this, but Smith is certainly wrong in the case of *Halictus*, and in general, when assigning hosts to the various *Nomadas*, appears to have formed his opinion from such bees as he saw on the same flowers as the parasites or flying about in the same vicinity.

Of *N. fabriciana* in his first edition he says that it is met with on Hampstead Heath "about the end of April and during May, and it has also been taken in Yorkshire in the month of July." April and May is the normal time for this *Nomada*, and *Panurgus* is not to be found then. In Yorkshire it was probably a late season, when Smith found specimens in July, and these belonged to the first brood, since he took fresh males of early spring bees at the same time (e. g., ♂ *trimmerana* and *cineraria*). For these reasons one cannot place much faith on Smith's observations as a whole, though, of course, in a number of cases he is correct. Some records of parasitism given by Saunders are also, I believe, incorrect, but it may be suspected that these were chiefly taken from Smith's works and not due to his own observation.

There are a few well-known Continental species of *Nomada* which attack species of *Andrena* common in this country, but are themselves unknown here. Such are *N. obscura* on *A. ruficrus*, *N. cinnabarina* on *A. labialis*, and *albo guttata*, a large race of *baccata*, on *A. sericea*. *N. rhenana* is said to be parasitic on *A. afzeliella*.

It is, I think, very rare for a species of *Nomada*, or even for a group of closely allied species of this genus, to attack *Andrenas* that are widely separated in structure, and consequently the study of their parasitism will help in fixing the affinities of species and of groups in *Andrena*. Of course this rule is not without exceptions. The *ruficornis* group of *Nomada* is attached to the *varians* group of *Andrena*, but *N. flava* and *N. bucephalae* attack that of *N. trimmerana*, a distinct group, but still clearly allied to that of *varians*. I know no case in our British *Nomadas* where the same species of parasite attacks *Andrenas* belonging to two distinct groups, though, if we accept some of Smith's conclusions, such cases would be not uncommon and of a most surprising character.

The most remarkable divergence found in our British species is in the case of *N. flavipes* (*solidaginis*). Obviously this parasite belongs to a most distinct group, including *N. tormentillae* (*roberjeotiana*) and *obtusifrons*, which attack *A. tarsata* and *coitana*, but itself is especially attached to *A. fuscipes*, belonging to quite a different group of *Andrena*.

In the present state of our knowledge I think it a mistake to accept numerous and diverse species of *Andrena* as the host of a single *Nomada* on casual observations. It is quite certain that parasitic bees, either for shelter or in search of their proper host, do at times enter burrows of species on which they are not parasitic, and certainly non-parasitic bees that burrow in the ground do sometimes make use of a burrow not formed by themselves, but by some other non-parasitic species, just as we know that wood-boring bees constantly make use of burrows formed by other Hymenoptera or by Coleoptera.

When Saunders tells us that *N. marshamella* parasitises *A. nigroaenea* and *atriceps* and Alfken supposes or conjectures that *nitida* is its host, one may not be able to prove that such is not the case; but when after very close attention to the habits of this *Nomada* in widely different localities one has found it peculiarly attached either to *A. trimmerana* Auct., or more rarely to its close ally *A. spinigera*, neither of which are mentioned, one would like to know on exactly what evidence it is assigned to species representing two quite different groups from that of its normal host. Both English and Continental writings are full of these abnormal associations of host and parasite, and since, as I have shown, we can be certain that many of these were mere guesses, we shall do well to look with suspicion on all such, until they have been thoroughly investigated.

In spite of their parasitic habits the *Nomadas* are freely attracted by flowers, but, as might be expected, in general the males visit these more frequently than the females. It is noteworthy that some species are particularly attracted by the same flower that is most attractive to their hosts. Thus, as is well known, *N. armata* and *atrata* frequent the flowers of scabious with *A. hattorfiana* and *marginata*, *N. tormentillae* those of *Potentilla* with *A. tarsata*, and so with others. This seems particularly the case, where the *Andrena* affects a very limited number of plants—a fact in itself of considerable interest.

The females of *Nomada* naturally spend most of their time either searching for the burrows of their hosts or in the neighbourhood of these. When a large number are seen hovering over the mouths of the burrows of some compact colony, investigating these on the wing before entering, they present a most striking appearance—not only large species like *armata*, *lineola*, or *6-fasciata*, but even moderate-sized ones like *hillana*, *ruficornis* or *germanica* become conspicuous and appear to exhibit their bright colours to the best advantage. We may presume that these colours have some protective value against such predaceous animals as might attack them, since they are thus by the nature of their habits very much exposed to any such enemies as may be at hand. Certainly the *Andrenas* are not exposed to the same extent, for when once the work of provisioning their cells has begun, they as a rule quickly enter the burrows with their load of pollen, whereas the parasite is often very conspicuous while hovering over a bare soil for a long time together and investigating the burrows, to find one which is in a fit condition for its entry. Such a view of the coloration of *Nomada* is far preferable to that which supposes the wasp-like or conspicuous colours to be for the purpose of intimidating the host! For a time after their emergence the parasites appear to resort to the burrows, where they were born, for shelter at night and in unfavourable weather, but when the hosts become fully occupied with their labours, the *Nomadas* habitually remain out at nights. Some of them sleep clinging by the mandibles alone to the heads of flowering grasses, the legs all drawn close to the body and the antennae porrect, so as to resemble a little stalk. The bright colours of the body being much toned down by the closed and superincumbent wings, the bees closely resemble the seeds or flowers of grasses, and are often difficult to detect. Some may be found clinging to dead twigs or leaves, with which their colours also harmonise very well. On grasses I have taken large numbers of *N. hillana* and *germanica*, and also of the very minute *N. furva*; while attached to dead hedgerow branches I once found a number of ♀ *N. bifida*, and on heather many *N. rufipes*.

Probably all the species of *Nomada* possess a strong odour, more or less disagreeable to me in the case of *N. marshamella*, but rather pleasant in the case of

*N. goodeniana*. Kirby noticed it specially of the latter, "odore *melissae*, flagrantissima," while *N. lineola* (*cornigera* K.) "moscham redolet." Some at times feign death when alarmed. The sting even of the larger species is not at all severe, and when the bee is taken between the finger and thumb the cuticle is rarely penetrated, though vigorous attempts are made to do so. If the thin skin beneath the nail is pierced, the sting is sometimes sufficiently sharp, as I have myself experienced, to cause one to involuntarily relax one's hold of the bee, but the pain is short-lived. It is impossible to help noticing, that though the sting is feeble, the quite remarkable mobility of the abdomen admits of the weapon being used with a far greater range of movement than in most bees.

All the species of *Nomada* have a hard and thick chitinous cuticle, forming a stronger protection from injury than that of their hosts. Indeed, it may be accepted as an almost universal law that in parasitic Aculeata the integument is less easily pierced than that of the species they parasitise. Thus *Coelioxys* is harder than *Megachile*, *Crocisa* or *Melecta* than *Anthophora*, *Epeolus* than *Colletes*, *Psithyrus* than *Bombus*, *Chrysis* and *Sapyga* than their usual hosts, *Nysson* than *Gorytes* and *Harpactus*, and so on. Only perhaps in the case of a few species, which have lately taken to parasitism, as we judge, and not yet become greatly modified thereby, does this fact seem hardly apparent. This hardness of covering (accompanied as it often is by spines, prominences or projections) may be of use to the parasites as a protection from some predaceous enemies, or even conceivably to some extent from the unfavourable weather, to which their mode of life exposes them, but one cannot help suspecting that it is primarily as a protection against attacks of their hosts that their thicker armour is so regularly developed.

There is considerable difference of opinion as to the frequency of conflict between host and parasite. Shuckard particularly notices the fierce fights between *Anthophora* and *Melecta*, and I have described an attack on *Halictus* by *Sphécodes*. On the Continent Marchal saw *S. subquadratus* kill the ♀ of *H. malachurus* and take possession of its burrow. *Hedychrum* has been recorded in an often-quoted passage as being surprised and attacked by its host, and as protecting itself by its well-known habit of rolling itself up into a ball. It is probable that fights

between host and parasite are not infrequent, but that they occur in the burrow itself and are rarely observed in consequence. The fight between *Halictus* and *Sphecodes* observed by me was begun there, and Shuckard says of *Anthophora*: "if they catch the intruder" (*Melecta*) "in her invasion, they will draw her forth and deliver battle with great fury." The *Hedychrum* alluded to above was caught in the burrow by its host. It must often happen that the rightful owner of the burrow comes home and surprises the parasite within, but what takes place beneath the surface, in which the burrow is formed, is, except in special instances, as cited above, quite uncertain. The main object of the parasite must be a safe escape, and one may suppose that the hardness of the cuticle helps to ensure this. It is said that in the case of *Nomada sexfasciata* and its host *Eucera* the latter gives way to the parasite, but accurate and detailed information on such points is much wanted. It seems improbable that any host would tolerate an interference with the performance of its labour. It is certain that the parasites exhibit care or caution in entering the burrows, for one often notices many of our *Nomadas* hovering over the openings for some time before they determine to enter, or pass on to investigate another burrow. It would appear that either they wish to ascertain the presence or absence of the maker, or else perhaps, by some unknown means, to learn the condition of the contents of the burrow, as to its fitness or readiness for the reception of an egg. Whether the odours of the *Nomadae* and other parasites play any part in the event of collision between them and their hosts, or whether they are otherwise protective, *e.g.*, against predaceous creatures, or, again, are only of sexual significance we have no evidence.

In the case of the conflict between *Halictus* and *Sphecodes* observed by me, it would appear that the latter was the aggressor, but this may only have been apparent and not really the case. When the female *Psithyrus* insinuates itself into the nest of *Bombus*, it is probable that the beginning of the actual combat may be due to either one of them according to circumstances, but the harder *Psithyrus* is assumed to be generally victorious.

It is a notorious fact that in many cases the number of individuals of a parasite compared with that of the host varies extremely in different seasons. Thus one year

in a given locality an *Andrena* and its parasite may be both numerous, and the next year, though the former may be again plentiful, the latter may be very scarce or even not found at all. The cause of this is, I think, entirely due to the difference of habits, for the host in the shelter of its burrow is less affected by unfavourable weather conditions than the exposed parasite. A day or two with continued cold rains no doubt decimates the latter. On wet days we have often found *Melecta*, *Epeolus* and *Nomada* hanging on to herbage or shrubs in the manner described, soaked with the rain and torpid with cold. On the other hand, with favourable conditions *Nomada* is capable of very rapid increase, remarkably so in the case of some species that attack those species of *Andrena* that form large colonies. In such cases the parasite can enter and oviposit in a number of different cells in the time that it takes to store a single one. Consequently, in rare instances we have known a *Nomada* even to outnumber its host considerably, though such a success is not often likely to last more than one or two seasons. This phenomenon is not at all confined to *Nomada*, for under exceptional circumstances a careful examination of large colonies of *Anthophora pilipes* and *Colletes succincta* has shown an enormous preponderance of their parasites, *Melecta armata* and *Epeolus cruciger (rufipes)*, in some seasons.

From these general remarks on *Nomada* and other parasitic bees it will be seen that a wide field is here presented for accurate observations, our knowledge on many points being of the most slender kind. The most we can say is that one certain host at least is now known for every species of *Nomada* that we have in this country, excepting only *N. flavopicta*, which requires further investigation. How many of the associations recorded, whether by British or Continental authors, are correct, when they do not agree with those which are given here under the various species of *Andrena*, is quite uncertain, but it may be said with certainty that some are absolutely incorrect and impossible. Having found myself more than once deceived in assigning a parasite to host, even after having, as I thought, taken particular pains to be correct, I feel sure that it often needs great care and repeated observations to arrive at correct conclusions.

Not many of our British *Nomada* are regularly double-

brooded even in the south, while some which are so on the Continent have but one brood with us. This may be the case, even though the host be regularly double-brooded.

Several of our species are irregularly double-brooded, e. g., *N. flavoguttata* and *fabriciana*, both of which sometimes yield an abundant second generation. So too does *N. lineola* in some seasons, and perhaps generally in the extreme south. *N. marshamella*, when parasitic on *A. spinigera* frequently, and when on *A. trimmerana* (Auct.) occasionally, yields a summer brood; in the latter case generally partial and represented by only a few individuals, but in the former sometimes a copious one, females of which I have taken in plenty entering the burrows of the second brood of its host—the form named *A. anglica* by Alfken.

In August 1886, on the south coast I met with a second brood of *A. goodeniana* in almost incredible numbers, but strangely enough have never since met with a single example of such, though Hallett has observed a copious summer generation. I have seen an example of a second brood of *N. ruficornis* from Ireland, but not from elsewhere.

These examples of a second brood are in the case of *A. fabriciana* and *flavoguttata* much darker than the first, as may be seen when a series of examples is placed side by side; indeed, that of the latter has, I believe, been given a special name—var. *hoepfneri*—by Alfken.

The genus *Sphecodes* is essentially a parasite on *Halictus*, but three species appear to be strictly attached to *Andrena*, though the evidence is not so absolutely conclusive as one could wish. Of these species *S. rubicundus* is said to be a parasite on *A. labialis* both here and on the Continent, and certainly has been taken in closest company with that *Andrena* in Suffolk, Hampshire, Cambridge, etc., so that there would appear to be no reason to doubt this association.

*S. reticulatus* is said on the Continent to be attached to *A. argentata*, and certainly in localities where it occurs in this country, when extensive search has been made, this *Andrena* has always, I think, been met with. *Halictus prasinus* has also been suggested as a host for the *Sphecodes*, and, as it happens, this *Halictus* frequently abounds in the very same localities as the *Andrena*. On the other hand, *H. prasinus* occurs over a wide area of distribution in Britain, from which the *Sphecodes* has never been obtained,

so that the evidence that exists is clearly in favour of the *Andrena* as host, especially as on the Continent its burrows have actually been seen to be entered by the parasite.

*S. pellucidus* (*pilifrons*) is a constant parasite of *A. sericea*, but is more local than the host. It is interesting to note that though this *Andrena*, like *labialis*, is generally found provisioning its cells in May and June, the *Sphecodes* parasitic on them differ in their habits from one another.

*S. rubicundus* appears in both sexes in May and June and has no later summer emergence, the females not hibernating, while only females of *S. pellucidus* are found at the time when *A. sericea* is at work, these being hibernated individuals of that sex which have survived from the brood of both sexes that appeared in the later summer months of the preceding year. This indeed accords with the normal life-history of the genus, but the case of *S. spinulosus* alone as regards the time of emergence is similar to that of *rubicundus*, and is the more remarkable because it is a parasite on *Halictus*, the species of which genus agree in the time of their emergence and in the hibernation of their females with normal *Sphecodes*. Consequently, *S. spinulosus* differs greatly from the normal habits of its genus in its life-cycle and also in like manner from its host; *S. pellucidus* resembles its congeners in this respect but differs greatly from its host; while *S. rubicundus* differs from the normal of its congeners but resembles its host. All other of our *Sphecodes*, so far as has been ascertained, are parasitic on *Halictus* and have the same habits as the latter, in so far as males and females emerge together after midsummer, the males dying before winter and the females hibernating.

The parasitic Strepsiptera of the genus *Stylops* attack many more of our species of *Andrena* than do the *Sphecodes*. In the Entomologist's Monthly Magazine 1918 (pp. 67, 115 and 129) I have given a list of such species as have been found styloped in this country and a synopsis of such species of *Stylops* as are known to me, together with an account of the effects of the parasite on the host. The Strepsiptera that attack *Halictus* are a different genus from those parasitic on *Andrena*, and belong not to the genus *Halictophagus* (which is parasitic on Homopterous bugs, and was given its generic name under a mistaken idea that *Halictus* was the host), but to *Halictostylops* or *Halictoxenus* of Pierce.

The changes produced by *Stylops* are sometimes so considerable that styloped examples will not agree with the characters given for the separation of the species, but I have never yet come across any so changed that the species could not be determined with certainty.

#### *Habits and Distribution of British Species.*

We may now consider the species in order from the point of view of their habits, and the parasites that affect them.

*A. albicans* is perhaps the most generally common of the whole genus, and is said by Smith to occur also in N. America. It frequents many flowers, and in the earliest warm spring days may be seen in numbers collecting its store or feeding on the willow catkins and dandelion blossoms. It abounds in gardens on the flowers of larger fruit-trees, on gooseberry, *Cotoneaster*; also on *Crataegus*, *Viburnum*, *Euphorbia* and many other plants. In most southern localities it is parasitised by *Nomada bifida*, which also occurs with it in the north, and has been taken, entering its burrows, in all parts of the country, showing a distribution as wide as that of its host.

*A. carbonaria (pilipes)* is a local species very partial to the coast, but also found far inland, as at Oxford. It sometimes forms large and very compact colonies in cliffs, and I have noticed them so near the foot of these as to be constantly damped by the sea spray at high tide. In the south it regularly has a full second brood, but at Oxford apparently only one as a rule. The first brood visits catkins of *Salix* and is very partial to blackthorn, and is also found more or less commonly on dandelions, cabbage and mustard, on hawthorn, *Euphorbia*, and other plants. The second brood is extremely partial to pink thistle and blackberry flowers. I have rarely, only twice or three times, found it styloped, and as often have taken *Nomada lineola* entering its burrows.

*A. tibialis* is a local species, its abundance in many localities around London having, no doubt, led to its being considered more generally common than is really the case. Over a large extent of country in Gloucestershire, Wiltshire and Devonshire, for instance, it is entirely absent, as is probably the case in many other counties even in the south, even though it may occur locally in them. Unless actual colonies be found, the females in my experience form

an extremely small proportion of the total number of specimens that are seen. It is an early spring bee, and visits the sallow catkins and is extremely partial to the dandelion, but also occurs on *Brassica*, *Tussilago*, and various other plants. In N.W. Germany it has a second brood, which differs somewhat from the first, but there it appears to be only exceptionally double-brooded, and I have seen no such specimens from England.

In some localities this species is very frequently stylopised, but not by any means wherever it occurs. It is parasitised by *N. lineola*, but only locally, and I have found it very abundant in some places without a trace of this *Nomada*.

*A. bimaculata*, unlike the preceding, is regularly double-brooded in the southern counties, at least. It is very partial to coast localities, but is also found on the commons near London, and is widely distributed in such places in Surrey. It abounds locally in Norfolk and Suffolk and in Berks, and is particularly common in Devonshire, where it ranges inland to a height of nearly 1000 ft. above the sea on Dartmoor. But it is always quite local. I have never myself found an extensive compact colony of this species, but have seen the burrows scattered, at most two or three together, over acres of sandy soil. In the spring these bees visit chiefly *Salix* and *Prunus*, and in some localities the flowers of *Ulex* and even *Bellis*; in the summer they are most partial to *Rubus*, but in some places have abounded on *Senecio*.

Near London and in the eastern counties red-marked varieties are frequently common, but in the far west they must be very rare indeed, as I have never met with one.

This species is occasionally stylopised. On the 12th of August, 1914, I took two females on bramble flowers containing the parasite, one of these, as is usual, being free from pollen, except such as might have accidentally adhered, but the other had gathered a full load, not only the hind tibiae, the floccus and hind femoral receptacle, but even the propodeal basket being filled. The first brood is also subject to the attack of *Stylops*.

*Nomada lineola* is an abundant parasite of this *Andrena* in Devonshire, and like its host is double-brooded there.

*A. flavipes* (*fulvicrus*) is a regularly double-brooded species in the south, and though decidedly local, where it is found, it generally occurs in great numbers, frequently

forming compact colonies of enormous size. It visits many plants, *Salix*, *Taraxacum* and *Ulex* being favourites with the first brood, but *Brassica*, *Sinapis*, *Veronica*, *Trifolium*, etc., are also resorted to; while the second brood is found on *Senecio* and other yellow Composites, thistles, yarrow, tansy, etc. In some places I have noticed specimens of the first brood numerously on daisies, *Tussilago* and blackthorn.

I have never myself found this species stylopised, but it is recorded to have been taken in this condition by Claude Morley.

It is parasitised by *Nomada fucata*, which in England is much more local than the host and apparently only infests its second brood. In N.W. Germany, as well as in Southern localities, it is found with both broods, and is very common; in the Bremen district, according to Alfken, almost more numerous than the host! According to Smith, *N. jacobaeae* is also parasitic on this *Andrena*, as he records that he took it entering a burrow (of the second brood); but it is curious that there should be so little definite knowledge as to the habits of this not uncommon parasite. I have found it sparingly in some localities, where the *Andrena* is still scarcer, and in others where I have not found the latter at all.

On the 22nd of April, 1914, I went to Sidmouth to examine a large compact colony of this *Andrena*, since it does not occur in my own neighbourhood. This colony I had found in August 1886, and I wished to see if any parasites were entering the burrows. So far as Hymenoptera were concerned, none occurred, but extraordinary numbers of the fly *Bombylius major* were hovering over the colony and every now and then touching the earth with the tips of their bodies, presumably in the act of oviposition. No change in the position nor in the extent of this great colony had taken place in the interval of twenty-seven years between my visits, and I have no doubt it was one of the great colonies recorded by Smith, as observed by him in 1871.

*A. gravida (fasciata)* is in England a local species, of apparently very restricted range in the south, having been found in Kent, Sussex and Essex, but as it has been recorded from Perth, it should occur in more numerous localities than have been noted. It is an early spring bee, and frequents shallows and also visits the flowers of

dandelions. It is, I believe, only single-brooded, but in Smith's collection there is a curious stylopised ♀ (which he wrongly considered to represent Kirby's *Mouffetella*) taken in Hampshire in the month of July 1840. I know of no other summer emergence nor of any other case of stylopisation.

*A. nitida* is a very widely distributed species, which generally is more abundant in meadowland and cultivated country than in wilder districts, but I have not myself collected in any part of the south of England, where it does not occur. It visits many different flowers, but is perhaps particularly attached to the dandelion. It visits *Salix* and *Prunus*, as do most spring *Andrenas*, also *Bellis*, *Brassica*, holly, *Cotoneaster*, *Ranunculus*, *Veronica*, various fruit-trees, e.g., cherry and raspberry, and Cruciferous plants. On all these I have seen it commonly, and sometimes it may be seen on the white dead-nettle. I have never known of a specimen of a second brood, although the species often reaches maturity in its burrow before winter.

It does not appear to be very subject to parasites, though I believe *Nomada goodeniana* (*succincta*) is supposed to attack it. I have not been able to satisfy myself as to this, and one field of large acreage, throughout which the burrows of *nitida* were dispersed, never yielded a parasite during several years' search, although the above-named *Nomada* was very common in the district, infesting *A. nigroaenea*. Still *nitida* is a very probable host of this *Nomada*. Stylopised specimens are quite rare or at least excessively local. This species is very widely distributed and occurs in the north of England and in Ireland.

*A. thoracica* is more local than the preceding and in the south is regularly double-brooded. The first brood is found freely on *Salix* and *Prunus*, and is also partial to dandelions and to cabbage and mustard flowers. The second brood is generally found on *Rubus* and pink thistles. Unlike *nitida*, it frequently forms large compact colonies. One colony found by my children in a hard-trodden sheep-track on the edge of Dartmoor appeared to consist of only this species, and fine large specimens of *Nomada goodeniana* were taken entering the burrows. Otherwise the pure colonies of this species that I have examined seemed to be free from these parasites, and it is, of course, possible that in the case mentioned there may have been burrows of the ubiquitous *nigroaenea* mixed with the

others. I suspect that the copious second brood of this *Nomada* previously referred to was bred in the burrows of *thoracica*.

The addition of *A. vaga* to our lists was made by myself on the discovery of a very ancient specimen of the ♂ in Walcott's British Collection, where it was named *A. polita*. I have little doubt that this specimen was taken in England. It is in some N. European localities the common host of *Nomada lathburiana*.

The beautiful bee, *A. cineraria*, is a local species, but of very wide distribution both in the north and south. It is mostly found in cultivated districts or meadowland, and is particularly attached to the dandelion, though it is sometimes found on heaths. At times it forms large compact colonies in trodden paths, but often its large burrows may be found singly or two or three together scattered over pasture-fields of large acreage, mixed with those of *A. nitida* and *nigroaenea* and such species as habitually frequent meadows, where there is an abundance of dandelion flowers in early spring. Not that it is in any way restricted to these flowers, for it is sometimes seen in numbers in gardens on *Brassica*, and the flowers of fruit-trees, and elsewhere on hedgerow plants such as the blackthorn, wild cherry, *Salix*, and even on the daisy.

*Nomada lathburiana* is the special parasite of this *Andrena*, but it is much scarcer than its host, and is entirely absent from many localities where the latter is abundant. I have never seen nor heard of a styloped example of *cineraria*. On the Continent it sometimes produces a second brood, but in Devonshire, where in some seasons it occurs commonly in March, no specimen of a second generation has ever been observed.

*A. nigroaenea* is a most abundant bee, ubiquitous in the south and common in the northern counties. Like its allies it is very partial to dandelions, but affects the most varied plants. Sallow, blackthorn, flowering fruit-trees and holly often attract it in swarms, not to mention *Brassica*, *Sisymbrium* and a host of other lesser plants. It appears very early in the spring and continues on the wing for a long time, especially in cold summers, when it may be seen even well into August, but it is never double-brooded so far as we know. *Nomada goodeniana* is its constant and often extremely abundant parasite, and very large examples of *N. fabriciana* have been taken at

its burrows, but it is doubtful whether it has other enemies in that genus, and unconfirmed records of others are probably erroneous. Styloped individuals are numerous, and of wide distribution, but are somewhat local in their distribution.

The small species, *A. gwynana*, is an interesting bee (though common and generally distributed) on account of its variation and in other respects. It is constantly double-brooded in the south. In the first brood both sexes normally have the face and the greater part at least of the sides of the thorax clothed with black hairs, with sometimes a few pale hairs about the scape of the antennae, while some of the second-brood examples quite resemble these. But in extreme forms of this brood nearly the whole face of the ♂ is clothed with pale brown or ochreous hairs, and in the ♀ sometimes a large part of it, while the whole sides of the thorax may bear similar hairs. In the ♂ especially, such variations are not easily recognised as belonging to the species at all, without critical examination, while those of the ♀ greatly resemble *A. angustior*.

The bees of the first brood obtain honey and pollen from the most varied plants, the dandelion being a great favourite, as also are the sallow catkins. But black-thorn, fruit-trees, daisies, speedwell, celandine, cabbage, starwort, etc., are freely visited.

The second brood shows some peculiarity in its habits. In some localities one rarely sees the ♀ collect its pollen from any plants other than *Campanula* and *Malva*, the two plants which at the same period are resorted to by *Cilissa haemorrhoidalis*, so that the two species are often in company. But in other localities the bees of this second brood are found abundantly on yellow Compositae and on the flowers of *Rubus*. Nor does this always appear to be due to the absence of the plants first named, for in one case a large bed of mallow in full flower, which was visited freely by *A. coitana*, was unnoticed by *gwynana*, although it was common on the yellow Composites and blackberry that grew around.

The extremely distinct species of *Nomada*, *N. fabriciana*, is an abundant parasite of *gwynana*, and in some localities and seasons produces a partial,\* more rarely a full second

\* By a "partial" second brood I mean that only a small part of the progeny of the spring bees emerge in the summer, the rest hibernating in the burrows.

brood like its host. In N. Wiltshire one or two individuals of a second brood were found only in certain seasons. This *Nomada* probably parasitises also both *A. nigroaenea* and *angustior*, so that, where all the hosts occur, one may find an abundance of the parasite in the freshest condition in April, and then in May and the first part of June there appears another abundant supply of fresh specimens of both sexes, mixed with old ones, mostly ♀♀, of the early issue. In July the true second brood appears, this generation appearing conspicuously darker in colour than the spring form, when a series of each is placed side by side.

In some localities stylopedised *gwynana* are not very infrequent, and those that I have noticed have mostly been examples of the second brood. Westwood, however, found the spring brood stylopedised commonly at Oxford.

*A. ruficrus* is a northern species and was first made known as British from some males captured in Perthshire in 1899. Just at the time it was brought forward, I discovered two or three females amongst some old Hymenoptera and miscellaneous insects collected in Yorkshire and mixed with *A. fucata* and other common northern species. In the north-west of Europe it occurs in early spring on *Salix*, dandelions and coltsfoot. In most places where it is found the small parasite *Nomada obscura* Zett. is taken with it, but as a rule only in small numbers. It should certainly be looked for in the northern localities where the *Andrena* occurs with us.

*A. angustior*, though a rather local and inconspicuous species, is very widely distributed in the southern counties, and in many places is abundant. It is found in the north of England also. It visits dandelions and other yellow Compositae, and in some localities collects much pollen from *Veronica*. At Oxford I found it numerous on *Ranunculus*, and wherever it occurs the ♂♂ will be seen flying round the blue hyacinth flowers, if these are present, though rarely settling on them. *Allium*, *Bellis*, *Euphorbia* and *Crataegus* are all attractive in one locality or another, and it is occasionally taken on white Umbelliferae. Normally it appears in May and continues in good condition into June, but in some years it appears in April, and fresh examples of *A. gwynana* may be taken on the same day. On the other hand, in some seasons it, or at least the ♀, may be taken in good condition in company with the second brood of *gwynana*!

*Nomada fabriciana*, I believe, parasitises this species; at any rate, it has been taken entering its burrows. These appear usually to be scattered, but I have seen a compact colony established in the face of a vertical cutting in a roadside bank. It is partial to woodlands and to hedgerows in cultivated districts or meadowland, and seems to prefer these to open heaths, though not absent from the latter. Normally the ♀ has the face beneath the antennae clothed with pale or whitish hairs, but varieties occur in which the pubescence is sooty or dark fuscous. These may easily be mistaken for the second brood of *gwynana*.

*Andrena trimmerana* \* Auct. is certainly one of the commonest and most widely distributed of the genus, being plentiful in England, Scotland and Ireland. It visits the most various plants, holly, willows, blackthorn, whitethorn, and fruit-trees, as well as the dandelion and daisy, besides many garden shrubs of foreign origin. It seems to be nearly always single-brooded. Generally its burrows are scattered over fields or grassy slopes and along hedgebanks, and it has a liking for forming these in some existing cavity, and may sometimes be seen exploring a rabbit or rat hole for this purpose. Everywhere *Nomada marshamella* appears to be its special parasite, except that it also sometimes attacks the closely allied *A. spinigera* and possibly *A. bucephala*. It has a second parasite, *N. flava* (considered by some to be a variety of *ruficornis*), which so far as I have been able to discover, seems to be peculiar to it, but is a good deal more local than *marshamella*, and is absent from many localities where the host abounds. In some localities this *Andrena* is very commonly found stylopised, in others it is very rarely thus affected.

*A. spinigera*, closely allied to the preceding, is much more local and has not been recorded from very many localities, nor have I seen any northern examples. It is always double-brooded, and occurs in the London district, in Surrey, Kent, Suffolk, Essex, Sussex, Hants, Somerset, Dorset, Devon and Cornwall, and no doubt other localities. Owing to confusion with the next species the records of these are not always trustworthy. The bees of the first brood are mostly found on willow and blackthorn, but they are fond of fruit-trees in gardens and of various foreign shrubs. The second brood (*anglica*) seems to be chiefly

\* The type of *trimmerana* in Kirby's collection is not the species commonly so-called, but a ♀ of the second brood of *spinigera*.

found on *Rubus*, but it has been taken on white Umbelliferae. Occasionally *Nomada alternata* parasitises this species, and like it produces a second brood. Stylopised examples occur, but much less often than in *trimmerana*.

*A. rosae* (*eximia* = first brood) has been much confused with the preceding, the two not infrequently being found in company on the same flowers. But in some localities the one is found quite apart from the other, as appears to be the case in Monmouthshire and parts of S. Wales, where only *rosae* has occurred. True *rosae* is also found in Surrey, Kent, Sussex, Hants and Devon, and no doubt in a number of other counties, but is local and often rare. The first brood visits willow and *Prunus*, and where these have been growing in fine flower side by side, it seems to prefer the latter; the second brood seems to be particularly attached to white Umbelliferae, though like most summer forms it is also found on *Rubus*. In this respect, therefore, its habits would seem rather different from those of *spinigera*. As I have elsewhere stated, when it was possible to study the three allied species where they occurred in company in the spring, no evidence of cross-pairing between them was obtained; nor has any individual been found which would suggest that such pairing ever occurs, all the specimens being clearly either one or other of the species, without intermediates. I have no knowledge whether this bee is attacked by *N. marshamella* like its allies, nor have I found any stylopised examples, but as they are thus affected in N.W. Europe, it is possible that such specimens have been taken by others. On the Continent *A. rosae* appears to be a more northern species than *spinigera*, and one would expect it to range into Scotland. The entirely black variety of the ♂ of the first brood is rare in Devonshire, where the species is generally highly coloured, and this variety has a remarkable appearance, quite unlike any other of its genus.

*A. ferox* is a species of wide distribution in the south, but very local, and seems never to have been obtained plentifully since the old Bristol collectors used to find it in considerable numbers in that district. Yet, since it occurs in Kent, Berkshire, Hampshire and Sussex, and no doubt will be rediscovered (although its former Bristol locality has been built over) somewhere near its old western haunt, and has been also found in Cornwall, it will probably turn up commonly enough in some of these counties, or be

discovered in others. The few recent examples that I have seen have all been taken casually, so to speak, by those interested in Orders other than Hymenoptera, and all were single specimens. These were from Hants (on two occasions), Berks and Cornwall. It occurs in May and June, and may be expected to visit yellow Composites, as one examined by me contained this pollen on its legs. It is not known whether any *Nomada* is attached to this species, but it has been found styloped.

*A. bucephala* is another extremely local species, also of wide distribution in the southern counties, and found by Hallett in Glamorganshire in Wales. It was once very abundant at Hampstead, and was found also at Bristol and in Hampshire. It has been taken in several localities in Surrey, in Kent, at Birmingham, and occurs also in Devonshire and Cornwall. This bee is partial to the flowers of blackthorn, and has also been taken on holly and *Viburnum*.

From the form of its polliniferous apparatus one would expect it to visit such flowers as are favourites with the common *A. trimmerana*. *Nomada bucephalae* is its peculiar parasite, and has been erroneously considered a mere variety of *ruficornis* by some authors; while Smith and Shuckard considered it to be Panzer's *lateralis*, which is also an error. This parasite probably occurs in all localities where its host is properly established, for it formerly abounded on Hampstead Heath, and is found with it in Surrey, Devon and Glamorgan. Styloped *bucephala* occur, as I have a ♂ and ♀ so affected.

All the colonies of this *Andrena* that I have seen have had only a single entrance. Into this one may see dozens of heavily laden females enter, when they are storing their pollen, and it is to be presumed that separate tubes will be found to be excavated from the common hole, by which all enter. Under special circumstances some other species show some approximation to the habits of *bucephala*. Twice *Nomada alternata* has been seen to enter or issue from the burrow of *bucephala*, and once a female *trimmerana* entered the same, so that it is not certain that this *Nomada* is parasitic on the former as it is on the latter.

We now come to the group of *Andrena varians*.

*A. clarkella* is a local bee, but of extremely wide distribution, and appears as early in the year as any of our bees. It is often common in Scotch localities and in the north of

England, as well as in the extreme south. The females gather their pollen nearly always from the catkins of willows, but I have taken specimens on dandelion, and have some that were captured on *Tussilago* and *Ulex*. Though the males also visit willow catkins, they are by no means always found on these even when the species is freshly out, and if they are present they usually appear to be mostly in search of the females, rather than visiting the flowers.

In March and sometimes even in February before any new leaves have appeared this sex may be seen flying wildly round *Ulex* or settling on the bare limbs and trunks of trees or on dead leaves on the ground, for the purpose of sunning themselves. In many and I think in most places where it occurs freely, this bee will be found accompanied by its parasite *Nomada leucophthalma (borealis)*, which also visits the willow catkins. This *Nomada* is not confined to *clarkella*, but is also attached to *A. apicata*, and probably this latter is its original host. According to Saunders *clarkella* is found stylipised, but only rarely.

*A. fulva* is in the female sex the most beautiful of all our Andrenas. It is a local bee entirely absent from many districts, but generally abundant, where it occurs at all. Owing to its partiality for the flowering fruit-trees it is a constant inhabitant of gardens in places where it is found, and is not easily overlooked for that reason, and because its burrows are often conspicuous on lawns. It may be taken on the catkins of *Salix*, and is very abundant away from gardens on the flowers of blackthorn, and occurs, too, on *Cotoneaster*, *Ulex* and various other plants. Its colonies are often large and compact, occupying trodden pathways on sandy commons for many yards together. A large form of *Nomada ruficornis* s.s. infests its burrows, and it also has as a special parasite *N. signata*, which some hymenopterists consider to be also a variety of *ruficornis*. In some localities, e.g., at Oxford, only *ruficornis* appears to be found with it; in others, e.g., at Raglan in Monmouthshire, only *signata*; but on some of the commons in the neighbourhood of London both these species are found at its burrows.

Stylipised specimens of *A. fulva* are rare, or, at least, very local, but are to be found on the commons near London. Males thus affected often have an extraordinary appearance, being very greatly changed by the parasite.

*A. varians* has much the habits of the preceding; indeed, the two species are often found in the same localities, and both

may be entirely absent from large stretches of country that seem well adapted for them. Both visit the same flowers, and *varians* is also parasitised by *N. ruficornis*; by some writers its parasite is considered to be the typical form of this variable *Nomada*. Stylopisation occurs but rarely.

The variation exhibited by the ♀ of *varians* is of a remarkable character. One most extreme form was named *mixta* by Schenck, and considered to be a distinct species, and indeed its appearance is so very different from the typical form that, were no intermediates known, one would scarcely think it possible that he was in error. It is partly owing to this variation that such confusion has existed between the closely allied species of the *varians* group, for Smith referred the *mixta* form to *helvola*, and Saunders considered it to be *synadelpha*.

The following varieties of the ♀ may be distinguished :—

(i) Typical *varians* has black hair on the face, and the underparts of the thorax are clothed with blackish or sooty-grey pubescence, even the floccus being, at least in part, sordid in colour. The two basal abdominal segments bear bright fulvous hairs, all the others black ones. (ii) The fulvous hairs of the abdomen spread over the 3rd segment, the hairs of the underparts often become paler and the floccus whiter. (iii) Fulvous hairs, generally with more or less tendency to become white, cover the 4th as well as the 3rd segment, the facial hairs are greyish or whitish fuscous, the hairs beneath the thorax and the floccus either slightly discoloured, or else pure white. (iv) The hairs on the 1st and disc of the 2nd segments are fulvous, those on the rest of the 2nd and the two following white or hardly perceptibly yellowish, those on the face and whole underparts of the body mostly snow-white, or at most a little yellowish tinted in part. This is the true var. *mixta*, and in its finest condition it is a very beautiful insect.

*A. helvola* under normal conditions appears a little later than *A. varians*, and superficially is extremely like the var. *mixta* of that species. It is partial to dandelions, from which it often collects its pollen, but it visits many other plants for this purpose, e.g., *Crataegus*, *Rosa*, *Fragraria* in gardens, *Euphorbia*, etc. It is a decidedly local insect, and not always at all common even where it does occur, but probably be found somewhere in most of the southern counties of England, and it also occurs in the north (Cumberland). It occurs also at Oxford, but, unless well authenti-

cated, published records are of little value, owing to frequent misidentification. Smith's supposed Scotch specimens are a mixture of *A. praecox* and *synadelpha*.

It is, I think, certainly parasitised by *Nomada ruficornis*, but I have not seen a styloped example, though these probably occur.

*A. synadelpha* is a very widely distributed species, but local. It occurs in many of the southern counties, and also in Scotland. The ♀ frequents the dandelion, hawthorn, wild rose and other flowers, and was taken in numbers together by Morice on *Sisymbrium alliaria*.

It is very much parasitised by *Nomada ruficornis* s.s., but is rarely styloped. The variation in the ♀ is somewhat similar to that of *varians*, but less extreme.

*A. fucata* is one of the most widely distributed of all our bees, being common in the north of England and in Scotland, and also in many parts of the west of England and in Ireland. It also occurs, sometimes not rarely, in the more eastern counties, in Suffolk, Hampshire and Surrey, also in Oxfordshire and Warwickshire, and on a very unfavourable and stormy day I observed it in some numbers in Bricket Wood, Herts. Probably it is to be found in nearly every county, but in many localities it is only seen in small numbers. Where it frequents gardens, the females are sure to be found gathering their pollen from the raspberry flowers; on wild heaths or moorland it frequents the *Potentilla* in preference to any other plant, excepting perhaps *Vaccinium* in some localities. Sometimes it may be taken freely on *Crataegus* and the wild rose, and late examples on *Rubus*. It is normally on the wing in May in Devonshire, but in some counties not usually until June, or even July in the north. I have never come across a large colony of this species, but I once found a small one of about a dozen burrows placed close together.

I believe that this bee is parasitised by *Nomada ruficornis* s.s., since I have taken the latter in places where I could find no other member of the *varians* group. Occasionally, but quite rarely, styloped individuals are met with.

*A. lapponica* is an extremely local species in the south, and can only be expected where there is a good growth of *Vaccinium*, since, so far as my limited experience goes, the ♀ collects its pollen only from this. The male is said to visit other plants, and in moorland localities is fond of flying round or settling on rocks. The burrows that I have seen

have generally been single or at most a few near together, and entering these or flying round the heath in the vicinity, examples of a dark form of *ruficornis* s.s. seemed as numerous as the host, which was by no means abundant. No doubt on moors in the north of England, in Wales, and in Scotland this *Andrena* is often very abundant, and specimens of the *Nomada* taken with it in the Grampians and sent to me for examination were of exactly the same colour variety as those found with it in Devonshire. Amongst the whole number of specimens that have been examined none were styloped.

*Andrena apicata* is one of the very earliest of spring bees, and it gathers its pollen almost entirely from willow catkins, though occasionally it visits *Prunus* for this purpose. It is of extraordinarily wide distribution, but very local, at least in the south. I have myself seen specimens from Surrey, Sussex, Gloucestershire, Devon and Oxford as well as from Scotland. In the west of England the males pay little attention to flowers. They may be seen flying round the willows in search of the females, but should there be old fences or gates in the vicinity of their breeding-place, they will generally be found sunning themselves on these, or will even settle on rocks. Occasionally a fresh female alights in a similar situation, evidently with the intention of pairing, and quickly attracts a number of the males, which are courting along the fence.

*Nomada leucophthalma*, which has already been mentioned as a parasite of *A. clarkella* (q.v.), attacks this bee, and it would be interesting to compare together long series taken from each host, each series having been collected in a place where only one of these hosts occurs. At Hastings Theobald found this *Andrena* to be much infested by *Stylops*, as is the case in Germany, but in the west of England I have never come across a styloped individual.

Alfken describes the ♂ of the German form of *apicata* as having a *small triangular* tooth at the base of the mandibles, and a specimen I have from the Continent agrees with this description; but in all British examples that I have examined the tooth cannot possibly be called small, and it would appear that the Continental form is racially distinct from ours. The tooth varies in shape in our examples, and it is quite possible by looking through long series of *praecox* and *apicata* to find individuals that do not differ much in the form of this.

*A. praecox* is closely allied to the preceding, and has the same habits, for both, at times, at any rate, form compact colonies of considerable extent, and both are pre-eminently attached to *Salix*. This species is local, but ranges from Scotland to the extreme south of England, and is, I think, commoner than *apicata*. It is found on the commons close to London, and is locally abundant in Surrey, Kent, Hants, Essex, Norfolk, Suffolk, Cambridge, Oxford and Monmouthshire. In Devon it is extremely local, and in places where I have myself observed it, it has steadily increased in numbers from 1914 to 1918, when it appeared in the first half of March. In Scotland it occurs, no doubt, commonly. Much scarcer than its host is its special parasite *Nomada xanthosticta*, which, however, is found just outside London, and in Norfolk, Suffolk and Cambridge. I have not been able to find any trace of this parasite in the west of England, even where the host abounds. From a large colony at Oxford I once took two styloped examples of the latter, but have not seen any so affected elsewhere.

Passing now to the *nigriceps* group, that most distinct species *A. denticulata* is very widely distributed, but at the same time very local. It occurs in many of the southern counties, in the north of England and in Scotland, but only rarely is it really abundant. In some seasons and places it is found at the end of June, but more often in July, and the ♀ may even remain on the wing into September. It is found on yellow Composites, *Senecio*, *Crepis*, etc., abundantly sometimes on *Inula*, and is extremely partial in some localities to pink-flowered thistles; while Smith says it is attached to bryony. That plant has never been in flower or has been wanting in the localities where I myself have met with *denticulata*. It seems not to be attacked by *Stylops*, nor has it a special *Nomada*, but *N. rufipes* (*solidaginis*) is parasitic on it as well as on the more abundant *A. fuscipes*. Except as to the development of male characters in large examples, this species varies very little, but the characteristic black hairs are sometimes wanting on the thorax in the ♂.

*A. tridentata* is one of the most restricted in range of all our bees. I have seen authentic specimens from Norfolk (Cromer), Suffolk and Hants, but the ♂♂ supposed to be this species, collected by Bridgman at Norwich, so far as the material sent by him to F. Smith is concerned, are all *nigriceps*. This species visits *Senecio* and *Crepis*.

*A. fuscipes* is widely distributed and often very abundant on the flowers of *Calluna*, to which it is chiefly attached, but we have once taken females loaded with pollen from yellow Composites, when the ling blossom was mostly over. It will probably be found on most extensive heaths, and is common in Norfolk and Suffolk in the east, as also in Surrey and Hants; in Devonshire and in Wales in the west; it is found in Cumberland, and Smith had specimens (wrongly named as *simillima*) from Loch Rannoch, Scotland. Unless a colony is found, and these are sometimes large and compact, the males usually appear to be much more numerous than the females, flying wildly over the ling or heather, or round sunny bushes that happen to be growing near by.

Probably in all places where this *Andrena* is found its parasite *Nomada rufipes* (*solidaginis*) also occurs, and in some Devonshire localities it seems even to surpass its host in numbers. In some seasons it appears before any of the latter are abroad, though the *Andrena* in this case appears not many days later. I have some suspicion, however, that the earlier examples of the *Nomada* were parasites of *denticulata*.

*A. simillima* is a local and in general a rare species, and seems to be found chiefly on the coast of Kent, Hampshire and the Isle of Wight, but it also occurs on the coasts of Devon and Cornwall in the west. I have only met with it on the flowers of thistles and on *Rubus*. Smith's specimens from Scotland were wrongly determined by him, being merely *fuscipes*, as mentioned above.

Closely allied to the preceding, the local and generally uncommon species, *A. nigriceps*, seems to have somewhat different habits. It visits various plants, and I have taken it on ragwort and other yellow Composites, thistles, *Knautia*, *Potentilla*, etc. On the Continent it is said to be most partial to *Jasione*, but that flower does not seem to be very attractive to species in the west of England. In Norfolk, Suffolk, Essex and Hants this bee seems to be fairly common locally, and it is found in N. and S. Wales; while I have two much-worn females which were, I believe, taken in Yorkshire. It is found both near Oxford and Cambridge, and in Cheshire and Lancashire, so that its distribution is very wide.

*A. sericea* (*albicus*) is common throughout the south of England, where conditions of soil are suitable, and also in

Scotland and Ireland. It is entirely absent from large areas, where the soil is of a heavy nature or of clay, and is very much at home on some coast sand-hills. It forms enormous compact colonies, often choosing hard, trodden footpaths or bare places on sandy commons to burrow in. It freely visits daisies and buttercups, but its favourite flowers are the yellow Compositae. Less often it collects pollen from bushes or trees of taller growth, such as the hawthorn. The males also freely visit flowers, but spend much time flying over the sand, in which the colonies are placed. This and the following species are probably representative of a fauna found in sandy wastes, the pale silvery hairing of the males being characteristic of many desert-loving bees, and adapted to their habits of flying over the sand.\* I should think that a good many species allied to our two are likely to be found in such places in continental lands, ours being, as it were, highly successful forms, which have been able to occupy regions beyond the ordinary limits of their natural environment. Also in such places one may expect that many species of other groups will superficially resemble them.

With us *A. sericea* has no *Nomada* parasitic upon it, but on the Continent of common occurrence is *N. alboguttata*, this being either a race of the smaller *N. baccata*, which infests *A. argentata* both here and abroad, or else a very closely allied species.

On the other hand, *Sphcodes pilifrons* is the constant parasite of this *Andrena*, and I believe attacks no other species. I have seen examples named as *pilifrons* from localities where *sericea* is certainly wanting, the nature of the soil indeed rendering the possibility of its occurrence extremely small, but these were always wrongly determined, being giant examples of *S. similis*.

As to *A. argentata*, this bee is in this country of very restricted range, being abundant locally, however, on the commons in Surrey, Berkshire and Hampshire, and no doubt is to be found in one or two of the other southern counties. It visits the flowers of *Erica* and *Calluna* and probably some of the yellow Compositae, and apparently has no spring brood in this country. *N. baccata*, its parasite, seems to occur in all localities, where the host is common, and I think in most, if not all of these *Sphcodes*

\* Mr. Morice has informed me that his captures in hot desert countries more resemble *A. fulvicrus*, etc.

*reticulatus* is to be found. There seems to be no doubt that the *Sphcodes* is peculiarly attached to this small *Andrena*. On the Continent it has been taken from the burrow of the latter.

*A. fulvago* is of very wide distribution; in some localities rare and dispersed, in others forming dense compact colonies, but so local that until one of these is chanced on its presence may remain undetected in the district. It likes a sandy soil, and is particularly attached to *Hieracium*. One would expect it to occur in most counties where conditions of soil are favourable, since it is found in Suffolk, Surrey, Sussex, the Isle of Wight and Hants; in Devon, Monmouth and South Wales in the west; in Warwickshire; in Yorkshire in the north, and in Scotland. It may appear in May, and is common in June, and continues into July or even August. Though I have closely examined colonies of this bee I have found no parasite at its burrows.

*A. polita* is now, perhaps, the rarest of all our *Andrenas*, and has very rarely been found since it was discovered by F. Smith. Being a large and conspicuous species it must be excessively local, since it could hardly be overlooked, and its range is probably very limited indeed. One would expect it to be found on yellow Composites, and it should be looked for in June and July in the south-eastern counties.

With *A. proxima* we pass to a group of very small and comparatively difficult bees, only the one just named being of medium size for the genus. It is a local species and often very scarce even where it does occur. In Norfolk, Suffolk, Kent, Dorset and Devon it is, I believe, to be obtained not uncommonly in its special localities; but it varies in numbers a good deal in different seasons. It is also recorded from Surrey, Hampshire, Gloucestershire and Cornwall, so that it is widely distributed in the south. It is peculiarly attached to the flowers of white Umbelliferae, on several species of which it may be found, both sexes alike visiting these plants. It is also partial to *Euphorbia*.

Probably in most localities, where it occurs at all freely, its special parasite *Nomada conjungens* will be found. Though so lately added to our lists, it is interesting to note that this species was taken one hundred years ago, there being a very good specimen in the Kirby Collection. It was first brought forward as British by Morice, who captured a single specimen in Dorset, and soon afterwards

a number of examples were found in the Chitty Collection at Oxford, after I had already found it amongst some unmounted and unexamined Devonshire bees. Although on the Continent this *Andrena* is very subject to the attacks of *Stylops* (those thus affected appearing earlier than healthy individuals, and being found often on dandelion flowers), I have seen no styloped English specimens.

*A. nana* K. (*schenkella* Pérez) is known as British only by Kirby's type, but will probably be rediscovered in the south-eastern counties, when more attention is paid to this group of small bees. It occurs in Germany, Switzerland and France.

*A. moricella* and *alfkenella* are probably first and second broods of a single species. The first I have taken on *Brassica*, *Veronica*, *Bellis* and *Potentilla*, etc., the latter on white Umbelliferae. The first brood appears a little later than *A. parvula*, and I have seen styloped examples of each brood.

*A. falsifica* is a local species, and its first appearance is rather later than that of *A. moricella*. It visits many lowly plants—daisy, wild-strawberry, *Veronica*, etc.—while the females gather much pollen from *Potentilla*. It is not rarely styloped, and has as a parasite *Nomada flavoguttata*. It is single-brooded.

*A. saundersella* (*nana* Auct. plur.) is a widely distributed species, probably occurring in all our counties, and abundant in some parts of the north of England. Its favourite flowers are *Veronica* and white Umbelliferae, from both which it gathers pollen, but it also visits daisies, *Myosotis*, *Potentilla*, *Fragraria*, etc., and late specimens may be found on *Rubus*. Very rarely a stray example of a second generation is met with. It is very subject to the attacks of *Stylops*, and also is parasitised by *Nomada flavoguttata*.

*A. nanula* is known to me as British only by a single ♀ sent to Smith by Bridgman of Norwich, and the continental examples that I have seen were taken in July.

*A. subopaca* is a very widely distributed species, found, I expect, in nearly all counties and common in the north. Such Scotch specimens as I have examined, passing under the names of *parvula* and *minutula*, really belonged to this species. It is mostly found on *Veronica*, *Bellis*, *Fragraria*, etc., and is normally single-brooded, appearing later than *parvula*. Once on the south coast I took a single ♂ of a second brood. It was the confusing of this species with *minutula* and *parvula* that caused Smith to err in

describing the ♂ of the latter under the name of *nigrifrons* in the first edition of his Catalogue.

This species is very subject to the attack of *Stylops*, and also of *Nomada flavoguttata*.

*A. spreta* is much more local than the preceding, and is chiefly found on the coast and on or about sandy heaths, but rather curiously it occurs also in the fen country in Cambridgeshire. It is single-brooded and flies with *saundersella*. So far as I have been able to ascertain from a careful investigation of its breeding-grounds, it is not attacked by *Nomada flavoguttata*, but it is very freely styloped. These little bees are very partial to different species of *Brassica*, and freely visit daisies and sometimes *Veronica*. There is no second brood.

*A. parvula* and *minutula* are certainly first and second broods of a single species. The first frequents the sallow catkins in the earliest days of spring, and gathers abundant pollen from blackthorn also, and later from *Crataegus* and *Veronica*. It is also often found on daisies, dandelion, cabbage, mustard, strawberry, flowers of fruit-trees and many other plants. The second brood is extremely partial to *Rubus* and various white-flowered Umbelliferae. Though sometimes styloped, this bee is much less subject to attack than some of its allies. I have after careful observations been able to satisfy myself that it is also less freely parasitised by *Nomada flavoguttata* in this country. The species seems to be ubiquitous, occurring somewhere, even in the poorest localities.

*A. parvuloides* and *minutuloides* may also prove to be first and second generations of a single species. They are much more local than the preceding, and generally found either on the coast, or on or near sandy commons, hardly occurring in meadowlands and well-cultivated districts, when these are remote from their normal haunts.

If they really are one species, I find the second brood far more commonly than the first. This latter is found on various flowers, *Veronica*, *Brassica*, *Bellis*, etc., but the second brood almost entirely restricts its visits to white Umbelliferae, and I cannot remember taking it on *Rubus*, which is so attractive to *minutula*, so that the habits of these two very closely allied forms are somewhat different.

I have seen no styloped example. The males are often much more difficult to find than the females, and appear on this account to be much less numerous, and the species is

rather later in appearance in the spring than *A. parvula*. The variability to which—apart from that due to seasonal dimorphism—both species are subject, sometimes makes them difficult to separate, but *minutuloides* occurs in Surrey, Kent, Suffolk and Devonshire, and, doubtless, in many other counties, but I have seen none from the north.

*A. dorsata* in the *wilkella* group is a local bee, which one would expect to occur in Scotland, unless it were there replaced by the very similar *A. propinqua* of N.W. Europe, a species (or ? race) with similar habits; but I have seen no Scotch examples. It is regularly double-brooded, the first generation frequenting *Salix* and blackthorn, but also many other plants. I have taken it in abundance on daisies and *Brassica*, gathering pollen from these; also on *Veronica*, *Rubus idaeus*, fruit-trees and dandelions, and late examples on white Umbelliferae. The second brood occurs on *Rubus*, yellow Composites, daisies and *Melilotus*, and sometimes on ragwort and *Potentilla*. Saunders mentions bryony as a flower visited by this brood, and Mr. Morice informs me that it is frequent on this flower in his garden. The species is found on the commons near London, and is abundant locally in Norfolk and Suffolk, and very common in numerous Devonshire localities, both on the coast and inland, to an altitude of nearly 1000 ft. above the sea. It is also found in Hampshire and Essex, and must occur in several other counties in the south. I have never seen any large compact colony of this bee, but only scattered ones. No *Nomada* appears to attack it, nor is it infested by *Stylops*.\*

*A. similis* Sm. is also local, but occurs on a number of commons close to London; was found commonly at Oxford in 1886, and is widely distributed, and in some places abundant, in Devonshire. It is recorded from Denbighshire and Essex, and is found in Hampshire. Some examples from Colchester sent by W. H. Harwood for my inspection many years ago had the face beneath the antennae clothed with pale fulvous hairs, instead of the usual white ones, this being the usual form in some N. European localities. Walcott first discovered it, at Bristol, and supplied Smith with specimens. Sometimes it forms compact and fairly large colonies, and the males will be seen flying over the soil and settling, for the purpose of

\* Recently my brother has sent me a styliposid female from East Devon, captured on March 26th, 1919.

feeding, on ground-ivy or bugle, if these happen to be growing there, as well as on daisies and *Veronica*. The females also visit these plants, and also trefoil and clovers, and they collect great loads of yellow pollen from the flowers of *Ulex*. Various papilionaceous plants attract them. No *Nomada* appears to breed in their burrows, nor have I been able to secure a single stylopised \* example, although, according to Alfken, this is one of the species of *Andrena* most subject to attack in Germany.

*A. ovatula*, better known as *afzeliella*, is by no means of universal distribution, but is widely distributed in the neighbourhood of London, and abundant in many counties, where there is heath land with a gravelly or sandy soil. It is not partial to meadowland and highly cultivated districts with heavy soils. It differs both from the preceding and the following species in being frequently and in some counties, *e. g.*, Devonshire and Hampshire, regularly double-brooded, but it is not certain whether it has not a special single-brooded race, which appears between the two others. It visits the same flowers as *A. similis*, but appearing earlier is also taken on *Salix* and on blackthorn. The second brood is extremely fond of *Calluna*, gathering pollen from this often in company with *A. fuscipes*, and is sometimes numerous on *Ononis*. This *Andrena* is not subject to the attacks of *Nomada* in this country, but it is sometimes stylopised, much less frequently, however, in my experience than *A. wilkella*. Most of the supposed stylopised *afzeliella* I have seen belong to the other species, but I have bred the ♂ *Stylops* from the present one as well.

The variation in this species is of an unusual kind in that the hind tibiae of the female may be either clear yellow, like those of its close allies, which never vary, or entirely black. This last form was named *fuscata* by Kirby (before he described his *afzeliella*), and it is found in both broods. Both names, however, are preceded by *ovatula* K., which is the ♂ of *afzeliella*.

Saunders merely tells us that *afzeliella* is widely distributed, but I do not possess any northern examples myself, though one would expect it to occur in both Scotland and Ireland. The following species, however, occurs in the north and the two are not always accurately separated by collectors.

\* Since this was written a stylopised ♂ has been taken.

*A. wilkella* is of very different distribution from that of the preceding, since it often occurs in extraordinary numbers on heavy clay soils and in highly cultivated meadowlands. It is true that it is found not infrequently in the same localities, frequenting exactly the same flowers as *ovatula* and *similis*, but where these two species are most abundant *wilkella* is often inferior to them in numbers. *N. hillana* (*ochrostoma*) is its special parasite, and does not appear to affect the others. Sometimes the *Andrena* forms colonies of huge extent and very compact, at others its burrows are scattered over a large extent of land. We have seen tennis lawns covered with little hillocks of soil thrown up by these bees in the same way as *A. fulva* is well known to do in similar places, where the soil is lighter.

Styloped specimens are very common, and females affected by the parasite are often found in dandelions, even when few healthy ones are to be seen on those flowers. It is always single-brooded, and though both fly together, it appears rather later than *ovatula* under normal conditions of weather.

There remain to be considered those species, which have the clypeus in the ♂ white, and along with these one without that peculiarity, but evidently closely related to one of the others.

This black-faced little bee, *A. nitidiuscula* (*lucens*), is amongst the most local of all our species, being restricted to a few southern counties, but almost certain to occur in at least one or two others from which it is not yet recorded. It is found on heaths or commons in Surrey, Sussex and Dorset flying over the heather, the ♀ visiting the black-berry blossoms. On the Continent it is said to be partial to Umbelliferae, as its ally *A. chrysoseles* is with us. This latter is a more or less local species, but occurs at times in the utmost profusion. It is on the whole more partial to meadowland than to more barren localities. It is found near London and probably in all or nearly all the southern counties, either locally or generally distributed, in Cambridge, Essex, Suffolk and Norfolk in the east, in Gloucestershire, Devon and Monmouthshire in the west, in Dorset Berks and Hants, Oxford and Warwick, and in Glamorgan, and no doubt other Welsh counties. Though not one of the earliest bees, in forward seasons it may appear in April, and is commonly found from May into June, and

may remain even into August in wet and cold summers. At first it visits daisies and dandelions and not infrequently buttercups and *Veronica*. Later it is particularly attached to white Umbelliferae, and it is much attracted by *Euphorbia* in some places. No *Nomada* parasitises it, and only very locally or one may say rarely is it stylopised, though it is found thus affected in localities so distant as Oxford, Devon and Essex. From the latter county Mr. L. Walford kindly sent me several such examples, including a ♂ with black face and ♀ with this part white-marked.

*A. tarsata* (*analisis*) is a local bee, and probably absent from those counties in the south which have no extensive heaths on a peat or sandy soil. It is still found just outside London, as well as on the more distant of the Surrey commons, and commonly in Hants and Devon. In the northern counties it is often abundant, and it occurs (no doubt abundantly) in Scotland and Ireland. It is extremely fond of *Potentilla*, gathering most of its pollen from this, but is also found on heather and *Rubus*. It is parasitised by *Nomada tormentillae*, which I have taken entering and leaving the burrows of compact and pure colonies of this little *Andrena*. Probably it is parasitised also by *N. obtusifrons*, at least it certainly is so, if one trusts old records. Smith, entirely misinterpreting Kirby's description, applied the name *xanthosticta* K. to that species, and under this name we read of *obtusifrons* as being parasitic in colonies of *tarsata* in the north. On one occasion this *Nomada* was taken sparingly, in company with a few of the *Andrena* in N. Devon, but not at the burrows of the latter, and it is, of course, possible that the following species may have been present, but overlooked.

*A. coitana* is not infrequently found in company with the preceding, but is, I think, more widely distributed in the south, though quite local. It is common in some places in the north of England, and occurs in Scotland. In the south it frequently occurs on the coast, and it is probably to be found somewhere in most of the counties. It occurs in the Cambridgeshire fens, and at Oxford, and in Devonshire on Dartmoor and Exmoor, as well as at lower elevations. It is common also on some of the Surrey commons and in the New Forest, and is found in Norfolk, Essex and Kent in the east. It is partial to the flowers of bramble, and in some localities (like *A. gwynana bicolor* and *Cilissa haemorrhoidalis*) visits the flowers of *Campanula* and

*Malva*, also white Umbelliferae and others. It is parasitised by *N. obtusifrons*, but not, I think, by *tormentillae*. At any rate, where we have found *A. coitana* and *tarsata* together, the last-named *Nomada* was certainly attached to the latter, and was not seen at the burrows of the former.

*A. hattorfiana* is widely distributed in the more southern counties, but local, and by no means always common, where it does occur. In the east it has been found numerously in Kent, and has occurred at Colchester and near Norwich; in the Isle of Wight, Dorsetshire, Devonshire (where it is widely distributed but local and in some localities and places few in numbers) and various localities in Cornwall, in S. Wales and near Oxford. Its favourite flower seems to be *Knautia*, but it also visits *Scabiosa*, and will hardly ever be seen on any other plant than these, or on the first one only. The red-marked varieties are said to be abundant on the east coast in some seasons, but in Devonshire are extremely rare; near Oxford less so.

*Nomada armata* is parasitic on this species and also frequents the same flowers. Judging from the fact that Smith, who found this *Andrena* so abundantly on the east coast, hardly obtained any of the parasite there, and Saunders none at all, it would appear to be unexpectedly rare there, but otherwise it seems generally to occur more or less freely in nearly all the districts recorded for its host. Yet it will not be found with every colony, even though these are of long standing. Once I saw it really numerous in S. Devon in a large pasture field sprinkled over with scattered plants of scabious, where it was flying strongly in a brisk wind from plant to plant, but not settling on the swaying flowers. Being occupied in salmon fishing and without a net I was unable to secure even a single specimen, and though I knocked down and so obtained some of the *Andrena*, the harder *Nomada* was not to be thus stunned. When, in another year, I was able to revisit the spot, the field had been ploughed up and planted with corn.

*A. marginata* in its habits is very similar to the preceding, being most partial to and often found only on the common scabious, but I have taken it on *Centaurea* and frequently on the devils-bit scabious, and Hallett took the ♂♂ on *Lapsana*. Not infrequently it is found in company with *hattorfiana*, being similarly local. I have seen specimens only from the more southern counties, where it occurs in Cambridge, Essex, Suffolk, Norfolk, Kent, Surrey, Berks,

Hants, Dorset, Devon and Glamorgan, and no doubt in other counties, but it is always local. Sometimes it is very abundant, as on one occasion eighteen years ago, on the border of Suffolk and Cambridge, when I found a bank grown over with scabious with nearly every flower occupied and often two or three bees on a single blossom. All our colour varieties were present, but no trace of any parasites was found. In Devon I have not found highly coloured specimens, but they occur freely in Dorset. *Nomada argentata*, a very local and generally rare species, is the special parasite of *marginata*, but it has only been recorded from a few localities, in Surrey, Sussex, Berkshire and Kent.

*A. cingulata* is a widely distributed bee, probably to be found in nearly all the more southern counties at least, and it also occurs in the north of England, but is by no means always common. It not only frequents sandy commons, but is also partial to well-cultivated districts and is found high up in hilly districts, *e. g.*, the Cotswolds and Dorsetshire hills. It used to be extremely abundant in suburban localities, and this probably led to its being considered a much commoner species than is really the case. Thus Shuckard makes the obviously very erroneous statement, that it is perhaps the commonest species of the whole genus! In several extensive districts, where I have collected, it occurs very sparingly and even rarely. In some it forms large colonies, but these are generally local. All observers note its attachment to the flowers of *Veronica*, but the female sometimes collects pollen from the dandelion and the common buttercup, and the males also visit these.

Kirby records that he took the females on *Ranunculus bulbosus* in May, but his statement that the males occur in the autumn must be an error, and (although, of course, he knew this sex well) may perhaps be due to some momentary confusion between this and the males of *Sphcodes*. Hallett found this bee abundantly on *Aubretia* in a garden. Of very wide distribution, but apparently nearly always rare, is its special parasite *Nomada guttulata*; but as this occurs in suburban localities, in the eastern counties, and so far west as Devonshire, it may reasonably (being an obscure little species) be expected to occur, if specially searched for, in many localities, where the host thrives. Kirby described the ♀ as a variety of

*ruficornis*, and Smith's earliest description of *flavoguttata* ♀ was also made from *guttulata*.

*A. humilis* is a very local species, widely distributed, but probably absent from a good many counties, and in some so extremely local that one may expect that it is to be found in a number of others from which it has not yet been recorded. Its wide distribution is shown by its abundance here and there in Surrey, Kent, Hants, Devon and Cornwall, Gloucestershire, Oxford and Lancashire. It is particularly attached to *Hieracium*, but visits also other plants, *e.g.*, daisies, buttercups and dandelions. Often it forms enormous colonies in hard-trodden pathways. Its special parasite *Nomada ferruginata* is often found at these colonies, and is also of very wide distribution, but not always present, even where the host is abundant. On the Continent this bee is much stylopedised in some localities, but I have seen no British specimens affected.

*A. labialis* is found in many localities in the south; from the eastern counties to Gloucestershire and Cornwall in the west, and in Cheshire and Lancashire in the north. Its abundance in some places seems to depend on the fact that it forms large and compact colonies, often in some vertical cutting or bare exposed surface of a hedge bank, and where these colonies are found it is naturally very abundant. V. R. Perkins records several such colonies at Wotton-under-Edge in Gloucestershire in 1879, and states that the species subsequently entirely disappeared. In that neighbourhood I found this bee at various times from 1886 to 1907, but always singly, and also its burrows, but these too were isolated ones on grass-covered slopes. It certainly has a way of appearing and disappearing suddenly, as I have noticed in other localities. I have taken the ♀ on *Trifolium*, *Lotus*, *Veronica* and *Hieracium*, and in gardens on sage and seringa, and, no doubt, it visits numerous plants. Hallett takes it on *Salix* and *Cornus sanguinea*. Compact colonies sometimes become badly infested with *Stylops*, but no *Nomada* attacks it in this country. On the Continent a form of *N. cinnabarina* is said to be found with it. There seems to be little doubt that *Sphcodes rubicundus* is its special parasite, this having been found in connection with it, in such different localities as Suffolk, the New Forest, and the fens of Cambridge.

SYSTEMATIC.

POSITION OF *ANDRENA* AND *NOMADA* AMONGST BRITISH  
BEES.

*Andrena* and *Nomada* are both very distinct genera, the latter indeed is so peculiar in appearance and structure that it has been entirely misplaced by some Hymenopterists. Their position amongst our bees may be briefly shown as follows:—

1. (2) Hind tibiae without calcaria at the apex. . . . *Apidae*.
2. (1) Hind tibiae with calcaria.
3. (4) First cubital cell divided transversely by a vein or streak.  
*Bombidae*.
4. (3) First cubital cell not divided.
5. (6) Labrum long, reflexed in repose, the mandibles closed over it, so that at most a little of the base is exposed.  
*Megachilidae*.
6. (5) Labrum not thus concealed, the mandibles closing round its apical margin.
7. (10) Labrum large and without a specialised glabrous area or raised tubercle on its basal portion, often nearly evenly punctured or pubescent over its whole surface.
8. (9) Species nearly glabrous to the naked eye and without conspicuous pubescent bands (often metallic); abdomen without a definite pygidial area. . . . *Ceratinidae*.
9. (8) The nearly glabrous species have a definite pygidial area in both sexes; many are well-clothed and have conspicuous pubescent bands. . . . *Anthophoridae*.
10. (7) Labrum often small, or with a special glabrous area or raised tubercle at the base; sometimes it is concealed beneath a dense regular fringe of special hairs springing from the apical margin of the clypeus.
11. (12) Tongue acute at the tip. . . . *Andrenidae*  
(incl. *Panurgidae* of some authors).
12. (11) Tongue blunt or emarginate at the tip (except in males of some exotic forms).
13. (14) Three cubital cells in front wings; hind tibiae with a scopa. . . . *Colletidae*.
14. (13) Two submarginal cells in front wings; hind tibiae without a scopa. . . . *Prosopidae*.

ANTHOPHORIDAE.

1. (6) Face of ♂ yellow or with yellow markings and the tooth on the tarsal claws always long and sharp; ♀ with well-developed scopae on the hind legs.

2. (5) Three cubital cells in front wings.
3. (4) Seventh dorsal segment of ♂ without a longitudinal median carina; ♀ with or without distinct abdominal bands; if these are present the face is black. . . . *Anthophora*.
4. (3) Seventh segment of the ♂ with a distinct median carina; ♀ with banded abdomen and yellow-marked face.  
*Saropoda*.
5. (2) Two cubital cells; ♂ antennae very long. . . . *Eucera*.
6. (1) Face of ♂ either without yellow markings or if with these, the tarsal claws have a blunt, truncated\* basal tooth; ♀ without a scopa.
7. (10) Marginal cell rounded at the apex, which lies below the margin of the wing.
8. (9) Thorax very hairy, scutellum with two prominent spines posteriorly, concealed amongst the hair. . . . *Melecta*.
9. (8) Thorax nearly bare except for tomentose markings, the axillae forming a projecting angle on each side of the posterior margin of the scutellum. . . . *Epeolus*.
10. (7) Marginal cell pointed at the apex, ending in an acute angle on the marginal vein. . . . . *Nomada*.

## ANDRENIDAE.

1. (10) Two cubital cells in the front wings.
2. (3) Marginal cell truncate at the apex. . . . . *Panurgus*.
3. (2) Marginal cell pointed at the apex.
4. (9) First cubital cell on the lower side subequal to that of the 2nd in length. (The length is measured as if the lower side were straight.)
5. (8) Face not yellow in the ♂, hind metatarsus not extraordinarily dilated and clothed.
6. (7) Abdomen without dense appressed hair-bands on the apices of the segments ♀ with the calcaria simple.  
*Dufourea*.
7. (6) Abdomen with dense hair-bands; calcaria of ♀ spinosely serrulate, apex of hind metatarsus produced over the second tarsal joint in the form of a strong spine.  
*Rhophites*.
8. (5) ♂ face largely yellow; ♀ metatarsus of hind legs excessively

\* This character unfortunately cannot be used alone to separate the males of our parasitic genera from the non-parasitic, as the ♂ of *Melecta luctuosa* has the claws formed much like those of *Anthophora* and different from those of *M. armata*. It will, however, distinguish the females of the two groups, but the absence of scopae is more readily observed.

- dilated and so densely clothed that its outline is seen with difficulty; (abdomen in both sexes short or subglobose; legs of ♂ very incrassate). . . . *Macropis*.
9. (4) First cubital cell on its lower side notably longer than the second (form elongate, abdomen banded; ♀ with the scopae of hind tibiae and metatarsi yellow and extremely long). . . . *Dasypoda*.
10. (1) Three cubital cells in the front wings.
11. (14) Basal nervure very strongly curved.  
(Third antennal joint in ♂ very short transverse or nearly square in outline when viewed from in front; ♀ either with a median "rima" on the 5th abdominal segment or the hind tibiae are spinose and lack a scopa.)
12. (13) ♀ with well-developed scopa and with long plumose hairs at the base of the hind femora beneath; ♂ genital opening distinctly ventral. . . . *Halictus*.
13. (12) ♀ without scopae, ♂ genital opening at the tip of the abdomen or almost so. . . . *Sphcodes*.
14. (11) Basal nervure oblique, but nearly straight.
15. (16) ♂ with the 6th ventral abdominal segment widened on each side at the base with a hairy lobe, which is not covered by the deflexed margin of the dorsal segment above it; ♀ without a special sensory groove on the upper part of the face along the eye margins; apex of hind metatarsus outwardly with a lamella of hairs extended over the 2nd tarsal joint. . . . *Cilissa*.
16. (15) ♂ with the 6th ventral segment not thus modified. ♀ with a sensory groove, bearing a dense tomentum, on each side of the face above; apex of hind metatarsus without the special lamella. . . . *Andrena*.

With regard to *Andrena* and its allies, I consider that in the Andreno-Panurgine group are to be found the most primitive types of existing bees, from which have originated all other groups. The Prosopidae and Colletidae are derivatives of this group in one direction, the Anthophoridae in another; the two former are not primitive in the form of their tongue, but this has become modified for a special purpose in all females, and the males of most species have inherited this form from the latter. In many Prosopidae from the Australian region the tongue in the ♂ is pointed and may be excessively lengthened, and these represent the more primitive members of the family. Our *Colletes* is an extreme form, some exotic genera having a very

Andreniform *habitus*, with the ordinary triangular pygidial area.

As to *Nomada* it was correctly placed by the old Hymenopterists Kirby and Jurine next to *Epeolus*, and is Anthophorid, not in the least allied to the Megachilidae as Pérez concluded, and also very remote from existing Andrenidae, where Edward Saunders finally placed it. The genital armature of the male is to my eyes essentially Anthophorid, and is not at all like either *Megachile* or *Andrena*, and the form of labrum is conclusive, not to mention other characters. At the most one might allow that its ancestors left the Panurgine branch of *Andrena* at a time when these were not well differentiated, but I think this unlikely.

Of great interest is the condition of the ♀ ventral abdominal segments in the three parasitic genera. In *Melecta* the 6th segment is extremely narrow and compressed; in *Epeolus* and *Nomada* it is capable of entire retraction beneath the 5th and has a special armature, so that one may sometimes count only 5 ventral segments. In all our *Nomadas* it is armed on each side at the apex with some close-set strong spines, and it differs in thickness in different parts. In *Epeolus* it is produced on each side into two long processes, which are serrated on the edge. If one imagines the apical and median thinner portion of the segment in *Nomada* removed, two armed processes would be formed in this genus also.

Whilst *Nomada* still remains connected with the Anthophoridae by the parasitism of *N. sexfasciata* on the Anthophorid *Eucera*, *Epeolus*, so far as I know, has become parasitic only on *Colletes*, which is almost as far removed from the Anthophoridae in one direction as can be imagined.

#### CHARACTERS OF GROUPS AND SPECIES.

The characters given in the tables have been taken not from selected single examples of each sex supposed to be typical, nor yet from any special series of specimens, but are those which in a period of study extending over thirty years, during which great numbers of individuals have been examined, I have found most constant. Smith and Saunders, on the other hand, based their descriptions essentially on individual specimens, and placed special labels on those selected. In some cases this method seems to me to have resulted in characters being considered as of

specific value, when in reality they are far from constant. Since the tables were completed, I have myself verified them by the examination of individuals of all the species. They have also been tried out to some extent by Mr. F. D. Morice, and more completely by Mr. H. M. Hallett, such a test by others being, I think, of much greater value than one made by the writer.

Though neither groups nor species can be altogether satisfactorily placed in a linear arrangement, the following order is suggested.

Group of *A. TIBIALIS*.

*A. albicans* Müll., *carbonaria* L. (*pilipes*), *bimaculata* K., *tibialis*, K.

Group of *A. FLAVIPES* (*FULVICRUS*).

*A. flavipes* Panz. (*fulvicrus*), *gravida* Imh. (*fasciata*), followed by *florea* F.

Group of *A. NIGROAENEA*.

*A. thoracica* F., *nitida* Geoffr., *cineraria* L., *vaga* Panz. (*ovina* Kl.), *nigroaenea* K., *gwynana* K., *ruficrus* Nyl., *angustior* K.

Group of *A. TRIMMERANA*.

*A. trimmerana* Auct. (nec K.), *rosae* Panz. var. *eximia*, Sm., *rosae* Panz., *trimmerana* K. var. *spinigera* K., *trimmerana* K. (*anglica* Alfk.), *bucephala* St., *ferox* Sm.

Group of *A. VARIANS*.

*A. fucata* Sm., *lapponica* Zett., *varians*, *synadelpha* Perk. (*ambigua*), *helvola* L., *fulva* Schr., *clarkella* K., *apicata* Sm., *praecox* Scop.

Group of *A. NIGRICEPS*.

*A. fuscipes* K., *simillima* Sm., *nigriceps* K., *tridentata* K., *denticulata* K.

Group of *A. ARGENTATA*.

*A. sericea* Chr. (*albicrus*), *argentata* Sm.

Group of *A. FULVAGO*.

*A. fulvago* Chr., *polita* Sm.

Group of species with white clypeus in  
the ♂, with NITIDIUSCULA.

*A. labialis* K., *humilis* Imh., *coitana* K., *tarsata* Nyl. (*analis*), *hattorfiana* F., *marginata* F. (*ceyii*), *chrysoseles* K., *nitidiuscula* Sch. (*lucens*), *cingulata* F.

Group of *A. NANA*.

*A. nana* K. (nec Sm. Saund.), *alfkenella* Perk. var. *moricella* Perk., *alfkenella* Perk., *spreti* Pérez, *saundersella* Perk. (*nana*), *falsifica* Perk., *nanula* Nyl., *minutuloides* Perk. var. *parvuloides* Perk., *minutuloides* Perk., *minutula* K. var. *parvula* K., *minutula* K., *subopaca* Nyl., *proxima* K.

Group of *A. WILKELLA*.

*A. ovatula* K. (*afzeliella*), *wilkella* K., *similis* Sm., *dorsata* K.

The group of species with a white or yellow clypeus in the ♂ is composite, but need not on that account be rejected in dealing with our small fauna. Otherwise the groups are natural, though they would, of course, require modifications in their definition if a world, or even European fauna were under consideration, and also subdivision would be necessary. Even as they are here defined, many foreign species and some even from such distant localities as California or the Far East can be readily placed.

The species of *Nomada* might be arranged as follows:—

*N. germanica* Panz. (*ferruginata*), *argentata* H.-Sch. (*atrata*), *armata* H.-Sch., *guttulata* Sch., *obtusifrons* Nyl., *tormentillae* Alf. (*roberjeotiana*), *rufipes* F. (*solidaginis*), *flavopicta* K. (*jacobaeae*), *sexfasciata* Panz., *fucata* Panz., *goodeniana* K. (*succincta*), *lathburiana* K., *marshamella* K. (*alternata*), *lineola* Panz., *bifida* Thoms., *baccata* Sm. (*albo-guttata*), *hillana* K., *xanthosticta* K. (*lateralis*), *leucophthalma* K. (*borealis*), *bucephalae* Perk., *signata* Panz., *flava* Panz. (*ruficornis part.*), *ruficornis* L., *fabriciana* L., *conjungens* H.-Sch., *flavoguttata* K., *furva* Panz.

Group of *A. TIBIALIS*.

A distinct and well-marked group characterised by the strong rugosities of the anterior area of the propodeum, this area posteriorly, where it becomes declivous, always bounded or closed by a raised line or transverse rugosity.

In the males the abundance of hairs often interferes with a view of the area, and the following characters are very useful.

The clypeus is never white or yellow, the mandibles when closed always lie the one on the other, the tips not forming a cross, the third antennal joint (so far as British species are concerned) is always short, just equal to or sometimes a little shorter, but never at all longer than the 4th. In the ♂ genital armature the inner angles of the lobes of the stipites are always greatly and acutely produced, forming strong divergent spines. Comparatively few of our *Andrenas* have antennal characters as above, the 3rd joint being usually at least slightly longer than the 4th.

The females have the floccus of the hind trochanters perfect, and the abdomen never bears a special adomment of dense, short, white hairs on the apices of the intermediate segments forming conspicuous bands or lateral streaks. Except in *A. albicans*, the inner calcar of the hind tibiae is unusually long and curved and distinctive in appearance accordingly.

#### Group of *A. FLAVIPES* (FULVICRUS).

The two species *flavipes* and *gravid*a (*fasciata*) might perhaps be included in the group of *nigroaenea*, but the appearance of the females is very distinct. Short decumbent white (or almost white) hairs form 3 dense and complete pale abdominal bands, covering the apical impressions on the 2nd, 3rd and 4th segments. When these bands are abraded the impressions exhibit a very dense and fine distinct puncturation, and this combined with the clear and copious or dense puncturation of the basal segment, renders old and worn examples not less easily determinable than fresh ones. The surface of the abdomen is practically glabrous apart from these bands. The scopae are red or yellow and the appressed hairs of the 5th abdominal segment black or dark fuscous. The floccus is imperfect, the hairs of the basal part of the trochanter conspicuously different from the apical ones. The pygidial area is flat, without a raised median triangular portion.

The males are often less distinct in appearance, but are easily known by the definite minute sculpture on a large

part at least of the surface of the lobes of the genital armature. The armature itself in its general form is commonplace, the inner angles of the lobes of the stipites either subrectangular or slightly produced. The head is without special characters, and the 3rd antennal joint is about equal to the next two together. The abdomen beneath has a general clothing of long hairs, and no special dense ciliation at the apices of the segments.

*Andrena florea.*

The position of this species is uncertain, the male genital armature being very remarkable. The sparsely clothed, shining and clearly punctured abdomen, which is usually more or less marked with red is characteristic of both sexes. The pygidial area is of the simple or flat form. Even if it cannot be included in either, it is clear that this species comes close to the group of *flavipes* and to that of *nigroaenea*. It is more remote from the group of *trimerana*. The ventral segments of the ♂ have a specialised apical ciliation, and the floccus of the ♀ is not perfect.

Group of A. NIGROAENEA.

This group is typically represented by *nigroaenea*, *nitida*, *thoracica*, *cineraria*, *vaga*; less typically by *gwynana* and probably *ruficrus*, and with these may be included the more aberrant *angustior*.

The species are chiefly distinguished by negative characters. In the males the head is never of striking form, and the labrum is ordinary, not upturned, the mandibles never armed with a tooth at the base, nor are the lower occipital angles acutely produced backwards. The second abdominal segment in fresh examples has some distinct pubescence extending to the middle either in front or posteriorly or on the disc, or else the first segment has long hairs not confined merely to the sides. These hairs, however, are so thin and sparse in several species that they are easily abraded. There is no conspicuous adornment formed by minute dense hairs forming apical pale bands or lateral streaks on the dorsal abdominal segments.\* In the females the floccus is never perfect, though in *cineraria* and *ovina* it is nearly so, and the appressed hairs

\* Apparently a slight appearance of this is found in *ruficrus* and in some specimens of the second brood of *gwynana*.

of the 5th segment are dark or obscure, never clear yellow or golden, while the hind tibiae and their scopae are normal. As in the ♂♂ the abdomen lacks the pattern exhibited by the *wilkella* and *sericea* groups. The male genital armature is not remarkable, but *vaga* and *angustior* differ from the others in having the lobes of the stipites more or less broadly rounded at the apex.

It is convenient to consider our species as forming two subgroups, the first consisting of the (normally) large species, the males of which always have the 8th ventral segment showing a conspicuous hump or projection beneath before the apex when viewed laterally (*vaga*, *cineraria*, *nigroaenea*, *thoracica*, *nitida*): the other of (normally) medium-sized species, in which the outline of the 8th ventral segment beneath is at most a little sinuate (*gwynana*, *ruficrus* and *angustior*).

It must be remembered that the aberrant species *angustior*\* has close allies on the Continent with similar head-characters (lower occipital angles much produced backwards, mandibles long and strongly crossed at the tips, etc.), and of course the removal of such species to a group of their own would simplify the definition of the *nigroaenea* group.

#### Group of A. TRIMMERANA.

A very distinct group, the males distinguished at once by the fact that either the mandibles are simple at the apex, lacking the anteapical tooth seen in all our other species, or, if the mandibles are toothed, then the 3rd antennal joint is very short while the 4th is long and slender, appearing almost twice as long as the preceding on its shortest side, and the flagellar joints are shining beneath. The cheeks at the apex beneath always form a distinct slight angle, or else are there produced into a spine. In the females the 4th antennal joint is never transverse, generally appearing subelongate or at least a little longer than its width at the base, while the 5th is always distinctly elongate. In all the forms but one, the floccus is notably small and imperfect, but in *ferox* it is well-developed and perfect or almost so. The pygidial area is without a sharply raised median triangular area. Abdomen always with dense minute surface sculpture all over, never polished, the puncturation feebly impressed or subgranulate, sometimes practically effaced.

*A. bucephala* is remarkable for its highly aberrant genital armature in the male, while its ♀ is quite normal; *ferox* for the highly developed *floccus* and *scopa* in the female, while its male is comparatively closely allied to *spinigera*.

#### Group of *A. varians*.

This group is rather well represented with us, and the chief character of the males is to be found in the head and mandibles. The latter are always long and falcate, the tips forming a very distinct cross, never resting one along the other. In most of the species the mandibles are also armed with a distinct angulation or tooth on their lower edge at the base, and the lower occipital angles of the head are strongly produced backwards in a pointed form, the latter character being conspicuous also in those which lack the basal mandibular tooth.

But in *A. clarkella* the form of the head is less remarkable, though after removal of the pubescence it can easily be seen that the structure approaches that of the other members of its group, the lower occipital angles being hardly at all rounded off. Alfken wrongly separates this species from the *variens* group and places it next to *nigroaenea*, Saunders places it next to *fulva*, but then separates these from their proper allies by interposing *nigroaenea gwynana* and *angustior*, an unnatural arrangement. The species is best placed next to *apicata*, in my opinion. Some of the males of this group have the tubercle of the labrum upturned, as in the next following, but the different shape of the head and other characters readily separate them. The females are also quite distinct as a group by the entirely rugulose surface sculpture of the abdomen, nowhere polished, its feeble puncturation, long pubescence on the 1st and middle part of the 2nd segment at the least, together with the characters afforded by the perfect *floccus*, and the sharply raised triangular middle part of the pygidial area. The genital armature of the male has the lobes of the stipites well produced at the inner apical angle, but not acutely, and the sagittae are always widened by a rounding of their sides at the base. The 5th antennal joint is never very short and often slightly elongate.

The males of this group show some affinity to that of *trimmerana*, but it is probably more closely allied to the following.

Group of *A. NIGRICEPS*.

The males are easily characterised by the upturned tubercle of the labrum, combined with the fact that the head lacks the occipital characters of the preceding group and the mandibles are never armed with a basal tooth. Further the abdomen is distinctly banded with pubescence. The females also differ from those of the *varians* group in the distinctly banded abdomen, the less perfect floccus, some of the hairs at the base of the trochanter being comparatively thick and not much curved. In *fuscipes* alone the floccus is nearly perfect. All the species have the hind tibiae unusually wide apically, and the scopa on the outer surface of these is formed of hairs that are finer than usual, while those springing from the lower side are much less conspicuously curved up round the outer side of the joint.

Group of *A. SERICEA* (*ALBICRUS*).

We have but two species of this group. They are remarkable for the pale clothing of the males, which frequent sandy places, where the females form their colonies. Though not very long and falcate, the mandibles cross at the tips; the head and tubercle of the labrum are of ordinary form. The apical margins of the intermediate abdominal dorsal segments bear short white or pale hairs forming bands or lateral streaks. The inner apical angles of the lobes of the stipites are considerably, but not acutely, produced, and well separated from one another, the sagittae wide at the base from the rounding of the sides. In both sexes the basal abdominal segment is shining. The females have a perfectly formed *floccus*, and the abdomen has white apical bands on the intermediate segments; the scopa outwardly consists of silvery white hairs or of dark fuscous and silvery ones together, and the pygidial area is definitely and triangularly raised in the middle. There is a dense and distinct apical ciliation of the ♂ ventral segments.

Group of *A. FULVAGO*.

The alliance between the two species *fulvago* and *polita* is doubtful and certainly not very close, the differences between the male genital armatures being considerable and perhaps important. The flagellum in the ♂ of both

species is shining beneath, in *fulvago* remarkably so. The 3rd joint of the antennae is subequal to or else much longer than the 4th. The abdomen has a very distinct puncturation, and the basal segment is shining or polished. The females have very large yellow scopae of plumose hairs, and the appressed hairs of the 5th segment of the abdomen are entirely yellow or golden. The floccus is perfect in form. As in the ♂, the abdomen is shining, the 2nd segment practically glabrous, except at the sides, and densely and distinctly punctured.

#### Group of *A. WILKELLA*.

Excluding the aberrant species *A. dorsata*, the members of this group are easily recognised and closely allied to one another. The males are commonplace in structure with short mandibles resting one on the other, and not forming a cross at the tips. The head has no peculiarities of form, and the tubercle of the labrum is ordinary. The 3rd antennal joint is at most rather longer or rather shorter than the 4th, never approaching the length of 4 and 5 united in any of our species. The 4th is more or less elongate, an important character to distinguish the males from some others in which this joint is either transverse or just as long as wide. The abdomen is rugulose all over, with very feebly impressed punctures, the basal segment never smooth and polished between these, 2nd segment with only very short hairs on the middle parts, the ventral segments with long apical cilia. The propodeum is well clothed with long hairs except on the anterior area itself. Male genital armature commonplace, the inner angles of the lobes of the stipites are not notably produced, and the sagittae basally are not dilated from a rounding of their sides.

The appearance of the females is more distinctive in this small group, the general surface of the abdomen almost glabrous, and bearing dense narrow bands (sometimes widely interrupted in the middle) of short white or almost white hairs on the apical margins of the intermediate segments. The sculpture is as described for the males, and the band of the 2nd segment is never entire. Floccus perfectly developed over the whole trochanter.

*A. dorsata* is in a wide sense a member of this group, but were we considering foreign species it might well be separated therefrom as a subgroup. Closely allied species

resembling it in all important characters occur in Europe and N. America, and probably elsewhere. At first sight the male is a commonplace and obscure insect, not infrequently confused with other species in collections. It has most of the characters of the typical males of the *wilkella* group, but the 1st segment is sometimes quite shining, varying in different individuals, as does the puncturation, and the colour of the facial hairs and legs. It is remarkable for the long slender hind tarsi and rather thick hind tibiae, the whole length of the tarsi (excluding the pulvillus and claws) being not less than  $1\frac{1}{2}$  times the length of the tibiae, whereas in the ♂♂ of other members of the group the tibiae are normal and the tarsi are not  $1\frac{1}{2}$  times their length. The female is quite peculiar in its polliniferous organs, though otherwise exhibiting the normal *wilkella* characters. The hairs of the propodeum are very long, plumose and strongly curved so that they form a pollen-basket almost completely closed in, the hind tibiae are strongly clavate, being very wide at the apex and with a very short fringe formed by the scopa on their upper edge; on the outer side the scopal hairs are fine, so that the dense puncturation of the tibia is easily seen beneath them; the hairs of the lower margin are comparatively little curved upwards over this surface. The floccus is decidedly imperfect, the hairs on the basal portion of the trochanter being much less curved and thicker and less plumose than those on the apical.

#### Group of A. NANA.

With one exception all of this group are minute in size, only one or two of our other species approaching them so closely in this respect that they could be mistaken. Clearly the group itself is closely allied to the preceding one.

The males have short mandibles closing one on the other, and no peculiarities of the head or labrum. The 3rd joint of the antennae is never greatly elongated, though distinctly longer than its apical width, longer too than the 4th which is generally wider than long, rarely about square in outline. The propodeum is unusually bare above though hairy at the sides, so that not only the anterior area is glabrous but the parts adjoining this are only slightly less exposed to view. The basal abdominal seg-

ment is minutely rugulose under a strong lens (except in one species), and the second, except at the sides, is bare except for the presence of very short hairs. In some of the species the anterior area of the propodeum is distinctly and densely rugose over its whole surface. The clypeus is never white or yellow, though often clothed with white hairs.

It should be impossible to mistake the ♂♂ of the minute species of this group for those of any other, because of the latter any the least liable to be confused either have a white clypeus or else the mandibles form a slight cross at the apex. As to the one larger species (*proxima*), its well-exposed propodeum with the anterior area densely and distinctly rugose right up to the posterior declivity, combined with the subglabrous abdomen, which has white apical lateral streaks on the intermediate segments, gives it a most distinct appearance.

The females resemble miniatures of the *wilkella* group, but are at once separable by the thin and imperfect floccus.

From small species in other groups the rugulose abdomen, not polished on the basal segment, separates most of these females, or if this is polished, the area of the propodeum is distinctly rugose to the declivity. The hind tibiae are black (sometimes pallid from immaturity), the scopae never conspicuously yellow.

Group of species with white clypeus in the males together with *A. NITIDIUSCULA*.

This is not a natural group as compared with the others, but, as said already, in our small fauna it is convenient to keep the species together. In my opinion the *Andrenas* with a white clypeus are primitive forms, some of which have given rise to groups of species with the ordinary black clypeus. We have not even a pair of species in this group which can be said to be very closely allied, the white-faced *chrysoceles* and black-faced *nitidiuscula* alone being comparatively nearly related to one another. *A. analis* bears to *A. coitana* somewhat the same relationship as *dorsata* does to the rest of the *wilkella* group. Apart from these, each other species appears to me to be isolated, and Morice has shown how *A. humilis* represents a considerable number of species on the Continent. In addition to the fact that the clypeus is white or yellow in all but one

of our species, all the ♂♂ have a strongly elongated 3rd antennal joint (as compared with the 4th), this rarely being less than twice as long as the latter, and sometimes as much as three times the length.

*A. chrysoceles* and *nitidiuscula* are representatives of a well-marked group. The head of the ♂ is deeply emarginate behind, so that the lower occipital angles (seen from above) are quite strongly produced, the mandibles are rather long and form a distinct cross at the tips. The clypeus is remarkable in having a much more widely upturned apical margin than is normal in the genus. This is best seen when it is viewed from the base. The tubercle of the labrum is ordinary. Propodeum above sparsely clothed, so that not only on the anterior area but on a large space on each side the sculpture is easily seen. Scutellum with sparse or at least remote punctures, not very convex, rugulose all over; abdomen with the general clothing consisting of only very short hairs, shining and to the naked eye appearing nearly bare, the basal segment polished. Intermediate ventral segments with extremely dense specialised ciliation on their apical margins. Genital armature with the lobes of the stipites much rounded off at the angles, short or subglobose; sagittae expanded by rounding of the sides. Female in general characters like the ♂, the apical white fringes of the dorsal segments forming a more conspicuous pattern of bands or lateral streaks. Pygidial area without a sharply raised median triangular area. Floccus imperfect, the hairs of the basal portion of the trochanter comparatively short and little curved.

*A. coitana* and *tarsata*. In general facies, and in the greatly and somewhat sharply produced inner apical angles of the lobes of the stipites, as well as in the long hairs that clothe the ventral abdominal segments, a very dense and highly specialised apical ciliation being absent, these species resemble each other and are more closely allied to one another, than is either to any other species.

The following great differences are notable in the males. In *tarsata* the clypeus is somewhat widely margined, as in *chrysoceles*, the tubercle of the labrum is upturned, but does not rise above the curved apical margin of the clypeus, the mandibles are rather short and wide and repose one on the other, while the hind tibiae are more than usually wide or thick. In *coitana* the clypeus is very narrowly margined, the tubercle of the labrum ordinary,

the mandibles longer and forming a distinct cross at the tips in some aspects, while the hind tibiae are long and slender.

In *tarsata* ♀ the hind tibiae are comparatively strongly clavate, very wide at the apex, the scopal fringe dense above them, and its longest hairs appear only about half the width of the tibiae at their apex. The floccus is imperfect, the hairs on the basal part of the trochanter much stiffer and straighter than the apical ones.

In *coitana* ♀ the hind tibiae are slender, with a very long and less dense scopal fringe above, the longest hairs appearing about equal in length to the width of the apex of the tibiae. The polliniferous basket at the sides of the propodeum is quite rudimentary (in *tarsata* it is very fairly developed), but the floccus is perfect in form.

*A. marginata (cei)* is not at all closely allied to *hatterfiana*, next to which it is placed, and with which it agrees in its habits and variability of coloration.

Head of ♂ deeply emarginate and the lower occipital angles rather strongly produced backwards, but not at all sharp. Apical margin of clypeus with the lateral angles forming strong prominent teeth, the tubercle of the labrum very wide, upturned above the clypeal margin between the teeth of which it forms a well-curved outline. Mandibles long and slender crossing at tips. Propodeum at sides of the area with long hairs. Abdomen with dense special ciliation on the ventral segments. Genital armature small, inner apical angles of lobes of stipites not the least produced, but obtuse, sagittae very narrow at the base.

Female well clothed with long hairs on the parts adjoining the anterior area of the propodeum; floccus rather thin but perfect, all the hairs very slender and plumose; hind tibiae slender, with very long scopal fringe above, this being also somewhat lax.

*A. hatterfiana*. Head ordinary, clypeus not produced into strong prominent teeth on each side, the tubercle of the labrum not upturned, emarginate apically. Ventral abdominal segments with a specialised and dense apical ciliation. Inner angle of lobes of stipites strongly produced, the production obliquely truncate or feebly rounded at the apex. Hind tibiae somewhat strongly clavate.

Female with the surface of the propodeum adjoining the anterior area sparsely clothed, the lateral pollen-basket very rudimentary, much as in *coitana*, Scopal fringe

above the tibiae shorter and denser than in *marginata*, the floccus perfect.

Abdomen in both sexes polished, finely and remotely punctured, scopae and appressed hairs of 5th segment in the ♀ clear golden.

*A. cingulata* is entirely distinct in facies from any other of the genus, the pattern of colour and dense even puncturation of the abdominal segments being distinctive. In the ♂ the head, together with the labrum and mandibles, is not at all modified; the latter when closed rest one on the other.

The genital armature is very large and remarkable, the lobes of the stipites only touching for a small space, the inner apical angles rounded off and receding, the processes in dorsal view divergent at their apices with an obliquely truncate or very faintly rounded margin, forming an apical acute angle.

In the ♀ the floccus is perfect, the surface of the propodeum above well exposed, the abdomen almost glabrous, though dull.

*A. humilis*. Head and tubercle of labrum ordinary in the ♂, the mandibles resting one on the other to the apex. Propodeum above (adjoining the anterior area) with long pubescence. Abdomen conspicuously pubescent to the naked eye, without special pattern, the basal segment with notably granular puncturation. Genital armature with the inner apical angle very strongly produced, forming long subdivergent processes.

Female with the basal abdominal segment at least towards the sides with granular punctures, no distinct abdominal pattern formed by the pubescence, 5th and 6th segments with golden hairs. Hind tibiae with long scopal fringe of evidently plumose hairs above, the scopae large and golden, the floccus perfect, of plumose hairs throughout.

*A. labialis*. Not related to any other of the species with white clypeus and should probably be placed closer to the group of *nigroaenea* with the larger species of which and to that of *flavipes* it shows affinity. Head of ♂, and tubercle of labrum ordinary, the mandibles resting one on the other, not forming a cross at the apex. Genital armature with the inner angle of the lobes of stipites not produced, nearly rectangular, the lobes polished, not rugulose as in the *flavipes* group. Eighth ventral segment with its

process much like that of *vaga*. The intermediate ventral segments with special ciliation, excessively dense on the 5th.

Both sexes with the abdominal surface shining between the distinct punctures, the apical impressions of the 2nd and 3rd densely and distinctly punctured, a distinct pattern of narrow and interrupted bands formed by dense short white or whitish hairs on the apices of segments 2-4.

Scopa of the ♀ normal, floccus almost perfect, much as in *vaga* or *cineraria*.

In the following tables the natural sequence of the species is not kept in the case of the *Andrenas*, while the species of *Nomada*, on the other hand, follow in almost natural order, excepting *N. fabriciana*, which might probably be best placed next to *flavoguttata*.

The antennal characters are most easily observed in specimens which have these organs more or less at right angles to the long axis of the head, and the measurements are always to be taken from the front or lower side of the joints, the insect being held with its head towards the observer.

The floccus is best seen when the specimen is held as above, but with the back downwards. Bees that carry a load of pollen should be boxed alive and allowed to free themselves from this.

A "perfect" floccus is one in which the hairs that spring from the basal part of the trochanter are soft, plumose and much curved, and differ very little from those on the more apical part. If the basal hairs are stiffer or straighter and do not adapt themselves to the curve of the others, the floccus is imperfect. These differences will be at once appreciated if such a species as the common *A. trimmerana* is compared with any member of the group of *A. varians*. In other countries there are species in which there is no true floccus at all, but we have no such forms in Britain.

#### TABLE OF ♂ ANDRENA.

1. (16) Clypeus yellow or white.
2. (3) Second and 3rd abdominal segments red, forming a broad band between the black basal and apical segments; a large white spot on either side of the white clypeus.  
*cingulata*.
3. (2) Second and 3rd segments not all red.
4. (5) Clypeus with the anterior angles forming strong prominent

- teeth, the labral tubercle upturned and forming a curved outline between the teeth of the clypeus (easily seen if the head be viewed from beneath). . . . *marginata*.
5. (4) Clypeus and labrum otherwise.
  6. (7) A very large species with strongly infuscated wings, shining abdomen and thorax and the clypeus only yellow (no lateral spots outside this). . . . *hattorfiana*.
  7. (6) If large, the species have a dull thorax and abdomen, or else a large lateral yellow spot on either side of the clypeus.
  8. (11) Mesonotum and scutellum conspicuously shining or polished between the punctures; small species.
  9. (10) Clypeus and a spot on either side of it yellow, hind tarsi dark, the hind tibiae slender. . . . *coitana*.
  10. (9) Clypeus only pale, hind tarsi clear testaceous, hind tibiae thick. . . . *tarsata*.
  11. (8) Mesonotum and scutellum with rugulose sculpture between the punctures, not polished.
  12. (13) Basal abdominal segments with many of its punctures set in conspicuous granulations. . . . *humilis*.
  13. (12) Basal abdominal segment not granulately punctate.
  14. (15) Basal abdominal segment strongly punctured, well clothed with longish hairs all over; lateral facial spots large.   
*labialis*.
  15. (14) Basal abdominal segment very finely punctured, to a large extent nearly glabrous; lateral facial spots small or absent. . . . *chrysoceles* K.
  16. (1) Clypeus black.
  17. (24) Anterior area of the propodeum more or less coarsely rugose and always bounded behind at the middle (on or near the edge of the posterior surface) by a raised line or transverse rugosity. (The mandibles are always short and lie one on the other, the tips not crossed; the 3rd antennal joint is never at all longer than the 4th.)
  18. (19) Second abdominal segment clothed only with very short hairs, the hind tarsi and the hind tibiae (to a large extent at least) clear testaceous or yellow. . . *albicans*.
  19. (18) If the hind tarsi and tibiae are largely clear testaceous the abdomen has abundant long hairs. (In all the following species of the section the 2nd segment has long or longish hairs on the middle, except in abraded examples.)
  20. (21) Hind tibiae with black hairs. . . *carbonaria* (*piipes*.)
  21. (20) Hind tibiae with pale hairs.
  22. (23) Hind tarsi and tibiae dark, black or pitchy. . . *bimaculata*.

23. (22) Hind tarsi and usually the apices of the tibiae (except in some stylopid examples) conspicuously red or yellow.  
*tibialis.*
24. (17) Anterior area of propodeum not bounded posteriorly by a raised line or rugosity, or if conspicuously rugose all over, the 3rd antennal joint is at least slightly longer than the 4th.
25. (36) Third joint of antennae extraordinarily short, seen from in front only from  $\frac{1}{2}$  to  $\frac{2}{3}$  the length of the strongly elongated 4th, and not or hardly longer than its own apical margin; flagellum shining beneath.
26. (35) Mandibles ordinary, having a more or less distinct tooth before the apex.
27. (34) Cheeks usually forming merely a small prominent angle at the base of the mandibles, rarely with a distinct elongate spine; if the latter is present the face beneath the antennae is largely clothed with pale hairs.
28. (31) Abdomen without evident red or yellowish markings above or beneath, at most the apices of the segments subtestaceous.
29. (30) Face beneath the antennae with the hairs brown and black or often nearly all brown (fading to pale ochreous).  
*trimmerana* Auct.
30. (29) Face beneath the antennae with black hairs.  
*trimmerana* var. *scotica.*
31. (28) Abdomen either above or beneath or on both surfaces with evident red or yellowish markings, at least on some of the basal segments.
32. (33) Apices of hind tibiae more or less pale.  
*spinigera* var. *anglica* (= *trimmerana* K.)
33. (32) Apices of hind tibiae not pale, but concolorous. . . *rosae.*
34. (27) Cheeks with an elongate spine at the mandibular articulation and the face densely black-haired, sometimes with a few greyish ones intermixed. . . . *rosae* var. *eximia.*
35. (26) Mandibles simple, without a distinct tooth before the apex. . . . . *spinigera* K.
36. (25) Third joint of antennae not extremely short as in the above section.
37. (40) Mandibles simple, no tooth on the upper margin towards the apex.
38. (39) Third antennal joint shorter than the 4th, hind tibiae yellow.  
*ferox.*
39. (38) Third antennal joint not shorter than the 4th, hind tibiae at least for the most part dark. . . . *bucephala.*

40. (37) Mandibles always with a tooth before the apex.
41. (52) Mandibles at the base always armed with a distinct angular tooth on the lower margin, the mandibles themselves always very long, falcate, strongly crossing at the tips.
42. (43) Third joint of the antennae very elongate, about twice as long as the short 4th joint, this latter nearly square in outline (thorax and abdomen in fresh examples with fulvous hairs). . . . . *fulva*.
43. (42) Third joint sometimes considerably longer than, but not nearly twice as long as, the 4th, and the latter is itself quite elongate.
44. (49) Propodeum clothed with pale fulvous hairs, fading to pale ochreous or whitish; very few or no black hairs; thorax above in fresh specimens with fulvous clothing.
45. (48) Hind tarsi often entirely or at least with the apical joints clear testaceous; or else the mandibular basal tooth is short and wide, forming a simple angulation.
46. (47) Ventral abdominal segments with excessively dense fringes of white or almost white decumbent hairs, so that the abdomen beneath has very conspicuous and beautiful dense bands; tubercle of labrum, viewed from above when the clypeus is in the horizontal plane, narrower in comparison to the width between the angles of the front margin of the clypeus, and not distinctly emarginate. . . . . *helvola*.
47. (46) Ventral abdominal segments with the fringes less dense and distinct, the tubercle of the labrum wide and distinctly emarginate. . . . . *fucata*.
48. (45) Hind tarsi blackish or dark brown; mandibular basal tooth comparatively long and narrow, strongly prominent, except as an unusual aberration. . . . . *lapponica*.
49. (44) Propodeum clothed with pale hairs and on some part at least with many black hairs, the whole thorax above in fresh examples much less bright, more grey than in the preceding.
50. (51) Process of 8th ventral segment of the abdomen distinctly emarginate at apex; mandibular tooth usually broader and blunter and the 3rd antennal joint rather less elongate than in *apicata*. . . . . *praecox*.
51. (50) Process of 8th ventral segment rounded or truncate at apex, not distinctly emarginate. . . . . *apicata*.
52. (41) Mandibles at the base not armed with a distinct tooth on the lower margin, but at most with the margin somewhat rounded at that point.

53. (56) Lower occipital angles of the head very strongly acutely produced backwards, the abdomen clothed with long pale hairs on the basal segment and on the middle of the second, forming more or less of a tuft there, the rest inconspicuously hairy from the shortness of the hairs, and never with pale bands or fasciae.
54. (55) Third antennal joint very much longer than the 4th, which is short, nearly square in outline, as seen from in front. . . . . *varians*.
55. (54) Third antennal joint somewhat longer than the 4th, which in the same aspect as above appears very distinctly elongate. . . . . *synadelpha*.
56. (53) Lower occipital angles very seldom strongly and sub-acutely produced, and if so formed, then the abdomen is quite different in clothing from that of the above section.
57. (66) Tubercle of the labrum upturned, so that in an apical view of the head it interrupts the apical margin of the clypeus.
58. (63) Head seen from above with the hind angles simply rounded off, normal.
59. (60) Clypeus well clothed, but if viewed somewhat from the side the surface and sculpture beneath the hairs is easily seen; apical hair-bands of abdominal segments 3 and 4 almost perfectly decumbent concealing the surface beneath (3rd antennal joint hardly longer than the fourth). . . . . *fuscipes*.
60. (59) Clypeus \* very densely clothed, so that, viewed somewhat from the side, the surface is not, or hardly at all, visible; apical hair-bands of 3rd and 4th segments less appressed and the surface beneath, which is smooth and often shining, is easily seen.

(In normal examples the 3rd antennal joint is conspicuously longer than the 4th, the latter often nearly square in outline or very little elongate.)

61. (62) † Abdomen very pubescent, so that to the naked eye its

\* I know no other character that can be of much use in a table, and it is necessary to have well-preserved specimens. The antennal joints, the reflexed margin of the 6th ventral segment and apex of the 8th all vary in this group. Normally *fuscipes* has the abdomen less distinctly punctured than the two following species.

† These two species are generally easy to distinguish, but very difficult to tabulate, as most of the characters vary. In normal examples *simillima* is the smaller species, with more elongate and slender 3rd antennal joint, and with the dense white fasciae formed

- black colour is not very noticeable; hairs of clypeus, those beneath the cheeks and on the thorax beneath and basal parts of the legs, or on some of these parts distinctly fulvescent. . . . . *nigriceps*.
62. (61) Abdomen much less pubescent to the naked eye and the abdomen much blacker; hairs of clypeus, those beneath the cheeks, and on the underparts of the thorax, coxae and trochanters usually white (unless stained by pollen).  
*simillina*.
63. (58) Head seen from in front of abnormal shape, the hind angles a little prominent or turned outwards.
64. (65) Third and 4th abdominal segments, viewed laterally, clothed with very short erect pale hairs in front of the apical bands; cheeks ordinary. . . . . *3-dentata*.
65. (64) Third and 4th segments with very short erect black hairs; cheeks forming a small prominent angle at the mandibular articulation . . . . . *denticulata*.
66. (57) Tubercle of labrum not upturned.
67. (90) Extremely small species, the mandibles always short, the one resting on the other and not forming a cross at the tips; general surface of 2nd abdominal segment nearly glabrous, with only very minute hairs.  
(Fourth antennal joint short, generally transverse, rarely as long as broad, never elongate.)
68. (71) First two abdominal segments shining or polished between the punctures, the 2nd densely and distinctly punctured, sometimes so closely that hardly any surface remains between the punctures.
69. (70) Abdomen beneath dull or hardly at all shining; claw joint of hind tarsi dark. . . . . *nana* K.
70. (69) Abdomen beneath shining, claw-joints clear yellow, stigma of front wings very conspicuously pale. . . . *alfkenella*.
71. (68) First two segments of the abdomen not distinctly shining, but one or both are largely dull from the minute sculpture of the surface.
72. (75) Whole face clothed with blackish or sooty grey hairs.
73. (74) Stigma very pale even when viewed on the undersurface, claw-joints of tarsi clear yellowish; 2nd abdominal segment with numerous distinct but shallow punctures.  
*moricella*.

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by the apical ciliation of the ventral segments rather more clearly defined than in *nigriceps*. The latter often has numerous black hairs on the basal part of the 5th and sometimes of the 4th abdominal segments.

74. (73) Stigma much more obscurely pale in the middle, often darkish brown, especially when viewed from beneath, claw-joints of tarsi usually dark and the 2nd abdominal segment often impunctate or nearly so, or with extremely feeble punctures. . . . . *parvula*.
75. (72) Whole face not clothed with black or sooty grey hairs, the clypeus at least with pale brown, yellowish, or white hairs.
76. (79) Face at the sides beneath the insertion of the antennae, generally the median space between the antennae and base of clypeus, and some other parts of the head quite evidently bearing black hairs, easily seen in lateral aspect of the head.
77. (78) White streaks of short hairs on the apices of the 2nd and 3rd abdominal segments much less conspicuous or hardly noticeable in dorsal aspect; mesonotum more remotely punctured ( $\sigma$  not found after the beginning of June). . . . . *parvuloides*.
78. (77) White streaks conspicuous in dorsal aspect; mesonotum generally closely and evenly punctured ( $\sigma$  not before the middle of June). . . . . *minutula* var.
79. (76) Face with few or no black hairs beneath the antennae.
80. (81) The impressions on the apices of the 2nd and following segments are deep, dull and very densely sculptured, with the appearance of excessively close, minute puncturation; the basal segment is similarly sculptured along its apical margin; stigma pale, clypeus with white hair. . . . . *spreti*.
81. (80) Sculpture of apices of the first three abdominal segments not dense enough to make them dull as in the preceding, often the apices of some or all of them are shining in some aspects.
82. (83) Second and 3rd abdominal segments with strong apical impressions (especially the 3rd) which in most aspects are brightly shining or highly polished, the surface sculpture feeble or hardly visible; stigma pale; long snow-white hairs on the clypeus. . . . *saundersella*.
83. (82) Second and 3rd segments with the impressions shallower and the surface sculpture much more evident, so that in most aspects the surface is much less polished than in the preceding.
84. (85) Fifth antennal joint short, transverse, not much longer than the 4th, the 3rd as long, or all but as long, as 4 and 5 together. . . . . *falsifica*.

85. (84) Fifth antennal joint more nearly square, not appearing transverse, in outline, differing notably from the 4th.
86. (87) Mesonotum very dull, the punctures remote and very fine, sometimes wanting, or hardly visible amid the surface sculpture; scutellum never polished, at most rather less dull than the mesonotum. . . . . *subopaca*.
87. (86) Mesonotum generally either very conspicuously or more or less closely punctured, sometimes more or less shining, the scutellum often, in part at least, with polished surface.
88. (89) Mesonotum normally closely and evenly punctured, the face beneath the antennae in fresh examples with yellowish or yellowish-brown hairs. . . . . *minutula*.
89. (90) Mesonotum normally more irregularly punctured, often more or less highly polished, the scutellum usually with some part at least polished; hairs of the face white.  
*minutuloides*.
90. (67) Species generally at least medium-sized, those comparable in size and appearance with the *minutula* group have the mandibles forming a distinct cross at the tips in apical view.  
(Many but not all species have the 4th antennal joint longer than wide.)
91. (92) Hind tibiae and metatarsi translucent yellow, the former at most partly subinfusate; basal abdominal segment polished and clearly punctured. . . . . *fulvago*.  
(Flagellar joints of antennae shining beneath and in some aspects with narrow basal pubescent bands; mandibles short, not crossing at the tips; ventral abdominal segments with long specialised ciliations.)
92. (91) Hind tibiae usually dark or pale only at the apex; if as above the basal abdominal segment is not polished.
93. (94) Normally a large species, with white-haired clypeus, the abdomen polished and clearly and copiously punctured all over, the apical impressions conspicuously pale and without dense white hair-bands. . . . . *polita*.  
(Antennae with the flagellum more or less shining beneath, the 3rd joint strongly elongated, about twice as long as its apical width; mandibles not forming a cross at the tips; ventral segments with long specialised ciliation.)
94. (93) Those of the following species that are large and have a white-haired clypeus, have not all the abdominal characters of *polita*, as given above.
95. (96) Sides of head behind the eyes with the hind margin conspicuously raised or thickened. . . . . *nitidiuscula*.

- (A small species with the lower occipital angles strongly produced backwards, the clypeus abnormal, its apical margin strongly reflexed or upturned, and behind this flattened (or impressed) smooth and shining.)
96. (95) Sides of head behind the eyes normal.
97. (112) Third joint of antennæ as long as the two following together and about twice as long as its apical width, or still longer in some species.
98. (99) A small or rather small species, the apices of the apical impressions of the abdominal segments 2-4 with dense white fasciæ, their general surface practically glabrous, except for very minute hairs. . . . . *argentata*.
99. (98) Abdomen with long hairs on some of these segments or without dense white fasciæ.
100. (101) Abdomen under a strong lens dull, minutely rugulose all over, the puncturation effaced, clothed all over with long hairs. . . . . *clarkella*.  
(Mandibles long, crossing at tips; lower posterior angle of the head behind the eyes in lateral view subrectangular, at most a little rounded off.)
101. (100) Abdomen either more or less shining or considerably punctured or both.
102. (109) Clypeus with white hairs, at most very slightly tinged with yellow; abdomen without red markings.
103. (104) A large species, the thorax clothed with white or whitish hairs, the abdomen shining nearly glabrous and impunctate above, and without special apical ciliation of its segments beneath. . . . . *vaga*.
104. (103) Abdomen clothed with a good deal of pubescence or punctured or both.
105. (106) Head seen from above deeply emarginate, its lower angles strongly and subacutely produced, but the angles themselves are rounded off. . . . *angustior*.
106. (105) Head ordinarily emarginate.
107. (108) Basal abdominal segment polished, generally with some shallow, often ill-defined, longitudinal fluting on its apical portion; ventral segments with apical bands of dense white cilia. . . . . *sericea*.
108. (107) Basal segment punctured; ventral segments with long fine hairs and no conspicuous apical ciliation.  
*fasciata*.
109. (102) Clypeus with distinctly yellow, brown or black hairs or with these mixed.
110. (111) Abdomen black, the apical impressions of the 2nd and

following segments bearing short dense pale hairs,  
forming bands. . . . . *flavipes*.

(Ventral segments without highly specialised ciliations.)

111. (110) Abdomen red-marked, nearly glabrous to the naked eye.  
*florea*.

(Ventral segments with highly specialised apical ciliations.)

112. (97) Third antennal joint evidently shorter than 4th and 5th together, often very much shorter.

113. (113a) Legs and face both with black hairs. . . . . *thoracica*.

- 113a. (113) Legs and face not both with black hairs.

114. (117) Clypeus with white hairs, 1st and disc at least of 2nd segment with long or longish pubescence, apices of 3rd and 4th segments without short hairs forming pale lateral streaks.

(Species large in normal specimens.)

115. (116) Thorax with fulvous hairs in fresh examples; hind tibiae fringed with pale hairs above. . . . . *nitida*.

116. (115) Thorax with white or whitish hairs, generally mixed with black; hind tibiae with black hairs. *cineraria*.

117. (114) If the clypeus is white-haired the 2nd abdominal segment is glabrous (or bears only very short or few hairs) on the disc; abdomen in some species with distinct pale fasciae or lateral streaks of short hairs on the 2nd and following segments.

118. (121) Clypeus never white-haired, often clothed largely or wholly with black; if covered with brown or fulvous hairs the 2nd abdominal segment has conspicuous long hairs on the middle.

119. (120) Mandibles in apical view of the face with the tips crossing when closed, 3rd antennal joint seen from in front under a strong lens, without distinct projecting hairs beneath. . . . . *nigroaenea*.

120. (119) Mandibles in apical view not forming a cross at the tips, when closed; 3rd antennal joint under a strong lens with distinct short black hairs projecting in the arch beneath. . . . . *gwynana*.

121. (118) Clypeus in some species white-haired, never black-haired; when clothed with brown or fulvous ones the 2nd segment bears only short hairs in the middle or may appear nearly glabrous there.

122. (123) Clypeus with white hairs, those on the sides of the face bordering it, as is easily seen in lateral view, are black. . . . . *ruficrus*.

(Size of *gwynana*, abdomen with the puncturation nearly effaced, the surface dull, 2nd, 3rd, and 4th segments beneath with dense conspicuous ciliation of white hairs on their apical margins.)

123. (122) Clypeus often with fulvescent or brown hairs if it is white-haired, it is not bordered with black ones along its sides.

124. (125) Fourth joint of antennae short, nearly square in outline or even transverse in some examples; area of the propodeum conspicuously and evenly rugose all over, the wrinkles waved or vermiculate. . . . *proxima*.

(Clypeus with white or almost white hairs, sometimes slightly brown-tinged basally.)

125. (124) The 4th antennal joint appears distinctly elongate, sometimes as long as the 3rd; propodeum never sculptured like that of *proxima*.

126. (127) Hind tarsi long and slender, in dorsal aspect the 3rd joint is twice as long as its apical width. . . . *dorsata*.

127. (126) Hind tarsi with the 3rd joint in dorsal aspect not twice as long as its apical width.

128. (129) Fourth abdominal segment without an entire or almost unbroken narrow apical band, this and the 3rd having at most remnants of bands towards the sides.

*similis*.

(Hairs of clypeus white in fresh examples, 3rd antennal joint a little longer than the 4th.)

129. (128) If not abraded the 3rd and 4th segments of the abdomen have pale fasciae, that on the 3rd either entire or interrupted on the middle 3rd of the segment, that on the 4th entire or at least almost uninterrupted in the middle.

130. (131)\* In good specimens the 3rd segment has a distinctly entire or hardly perceptibly broken band, and the antennae are always shorter than in the following, but vary in details. . . . . *ovatula*.

131. (130) The band on the 3rd segment is interrupted or very indistinct for a space about equal to one-fourth or one-third the width of this segment; the antennae are more elongate. . . . . *wilkella*.

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\* I cannot satisfactorily tabulate these species from worn examples, as they can be distinguished only by slight characters (differing only in degree) if abraded.

TABLE OF ♀ ANDRENA.

A. (B) Very small (at most about 7 mm. long) black-bodied species, with dark hind tibiae; abdomen with the general surface above glabrous, the basal segment in nearly all dull from the surface rugulosity, as seen under a strong lens; if it is polished as in *nana* K. the propodeum has dense and (for the size of the insect) strong rugosities over the whole of its anterior area.

(Scopa pale, floccus imperfect, area of propodeum well exposed, the hairs around it being sparse.)

1. (2) Basal abdominal segment polished and with a copious distinct puncturation, the 2nd clearly and finely punctured, the punctures as dense as possible except on the apical impression, which has only sparse and shallow puncturation. . . . . *nana*.
2. (1) Basal segment rugulose, rarely shining, the 2nd with very feeble punctures amidst the rugulosities of the surface or without punctures.
3. (4) Nearly the whole flagellum beneath and the apical joint at least above red; basal abdominal segment distinctly shining on the disc, the minute surface sculpture hardly visible under a strong lens, except on the apical margin. *nanula*.
4. (3) If the antennae are coloured as above, there is a dense surface sculpture on the basal abdominal segment, making it quite dull on the disc.
5. (6) A dense snow-white band occupies the whole apical impression of the 4th abdominal segment, concealing the surface, except that there may be a slight interruption in the middle. . . . . *spretia*.  
(Apical impressions of 2nd and 3rd segments with very dense sculpture or minute puncturation, the 3rd segment with the impression deep; stigma pale yellow.)
6. (5) Apical impression of 4th segment not so concealed, the hairs being so spaced that the surface is visible between them, and in some species there is only a scanty fringe.
7. (8) Apical impression of 3rd segment deep, this and often that of the 2nd brightly shining or polished in some aspects, the surface sculpture being faint or hardly visible.

*saundersella*.

(Stigma pale in the middle; the anterior area of the propodeum nearly always with the rugosities failing posteriorly, where the surface appears merely granulate.)

8. (7) Minute sculpture of apices of 2nd and 3rd segments distinct, the apical impression of the 3rd never polished as in *saundersella*, and generally only shallow.
9. (12) Second abdominal segment always with more or less numerous punctures, often excessively faintly impressed, and difficult to see definitely amongst the surface sculpture, nevertheless always to be distinguished in one position or another.
10. (11) Basal abdominal segment along the apical margin with excessively dense sculpture (almost as in *spretta*) and quite dull, the surface there of normal form, only ordinarily convex.  
(Stigma pale with dark lower border.)  
*alfkenella* and *moricella*.
11. (10) Apical portion of basal segment with the minute sculpture very fine or feeble, so that in some aspects this part appears more or less shining; the surface is unusually convex and gives to the apical margin an appearance of being thickened (anal appressed hairs darkish fuscous).  
*falsifica*.
12. (9) Second abdominal segment impunctate or nearly, never with an extensive system of obsolescent puncturation as in the preceding, often a few very feeble punctures at the sides.
13. (14) Mesonotum and scutellum rugulose all over, dull, with exceptionally fine punctures usually hardly visible as minute points amidst the sculpture on the former, the appressed hairs of 5th segment always dark, sometimes with more or less golden tint. . . . . *subopaca*.
14. (13) Mesonotum and scutellum with closer or larger punctures, the scutellum (and sometimes the mesonotum) more or less shining in some forms, appressed hairs of 5th segment in some golden.
15. (16) Abdomen in dorsal view with distinct dense apical fringes of short hairs on the sides of the 2nd and 3rd segments in fresh examples. . . . . *parvula* and *minutula*.
16. (15) Abdomen in dorsal view with the lateral streaks not or hardly noticeable, and appearing extraordinarily free from any special marking in consequence.  
*parvuloides* and *minutuloides*.
- B. (A) Species rarely only 7 mm. long; one or two agree in most of the characters, and these small ones have the basal abdominal segment polished as shown in *nana* K. alone of the preceding group, but have not the dense even

rugosity over the whole anterior area of the propodeum as in that species.

1. (12) Anterior area of the propodeum strongly rugose and always bounded posteriorly just on the brow of the declivity by a raised edge or transverse rugosity; the species that have the 2nd abdominal segment glabrous on the disc lack a pattern formed by dense short pale hairs on the apical margins of the 3rd and 4th segments.  
(Very distinct and copious abdominal punctures always present.)
2. (5) Appressed hairs of 5th abdominal segment golden or golden red.
3. (4) Thorax densely clothed with bright brown or fulvous hairs.  
*albicans.*
4. (3) Thorax not thus clothed. . . . *carbonaria* var. *praetexta*.
5. (2) Appressed hairs of 5th segment black or dark fuscous.
6. (7) Thorax beneath and propodeum at the sides with black or sooty hairs, scopae beneath silvery white. . . *carbonaria*.
7. (6) Thorax beneath propodeum at sides not black-haired, scopae not silvery white beneath.
8. (9) Hind tibiae clear yellow or reddish beneath the scopa.  
*tibialis.*
9. (8) Hind tibiae dark.
10. (11) Abdomen more or less red-marked above or beneath.  
*bimaculata* and var. *decorata*.
11. (10) Abdomen not red-marked.  
*bimaculata* var. *conjuncta* and var. *vitrea*.
12. (1) Anterior area of the propodeum rarely strongly rugose (the rugosities often fading out posteriorly) and not bounded on the brow of the declivity by a raised edge or transverse rugosity. When this area is strongly rugose all over, the abdomen has an almost glabrous 2nd segment, and the two following have dense pale pubescent streaks on their apical margins.
13. (14) Hind tibiae translucent yellow, the mesonotum and scutellum to a large extent at least with black hairs.  
*tarsata.*  
(Hind tibiae unusually wide at the apex and with short scopal fringe above, abdomen nearly glabrous above with more or less distinct bands or streaks of short pale hairs.)
14. (13) When the tibiae are clear yellow, the thorax is not largely clothed with black hairs.
15. (16) General surface of the abdomen glabrous, the 2nd, 3rd, and 4th segments with dense pale streaks or narrow

fasciae of short hairs on the apical margins, the hind tibiae abnormally wide at the apex and with dense short scopal fringe above. . . . . *dorsata*.

(The scutellar-post-scutellar region very densely hairy, the hairs on each side of the propodeum forming a pollen basket almost completely closed in and more perfect than in any other species.)

16. (15) When the abdomen is as above, the tibiae are normal in shape and the scopal fringe long.
17. (26) General surface of the abdomen glabrous, basal segment never polished between the punctures, but rugulose under a strong lens, the 2nd, 3rd, and 4th segments with a pattern formed by dense, narrow apical bands or lateral streaks of pale hairs, and covered with fine, shallow punctures; these bands are formed only on the hind margin of the apical impressions of the segments. Scopae yellow or golden.  
(Floccus of hind trochanters perfect.)
18. (19) Hind tibiae wholly or for the most part dark.  
*ovatula* var. *fuscata*.
19. (18) Hind tibiae clear yellowish.
20. (21)\* Scutellum posteriorly and post-scutellum very densely clothed with bright brown hairs (in fresh examples) hardly less densely than at the sides of the former.  
*similis*.  
(Apical band of 3rd abdominal segment always widely broken, appressed hairs of 5th segment always golden, wings fulvescent.)
21. (20) Clothing of hind margin of scutellum and that of the post-scutellum not unusually dense, less dense than that at the sides of the former.
22. (23) Appressed hairs of 5th segment fuscous or sordid. *ovatula*.
23. (22) Appressed hairs of 5th segment golden.
24. (25) Wings clear or almost clear hyaline; band of 3rd abdominal segment entire in fresh examples. . . . . *ovatula* var.
25. (24) Wings subfulvescent; band of 3rd segment broken in the middle. . . . . *wilkella*.
26. (17) Species with a glabrous abdomen and a distinct pattern of narrow bands or streaks, as described in 17, have the surface of the basal segment shining between the punctures or lack the dense puncturation.

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\* Although this and the following species are distinguishable in worn examples by slight differences in sculpture, etc., I am unable to satisfactorily tabulate them on these characters.

27. (30)\* Second and 3rd abdominal segments as densely punctured as possible, with the general surface glabrous, and complete pale fasciae of dense minute hairs filling (or almost filling) the whole of their apical impressions; scopae yellow or golden, the appressed hairs of the 5th segment black.  
(Floccus of hind trochanters imperfect, the hairs on the basal portion too straight and stiff to form a part of it.)
28. (29) Pubescence of thorax beneath and the basal parts of the legs with pale brown or ochreous hairs; face beneath the antennae not white-haired. . . . . *flavipes*.
29. (28) Pubescence of thorax beneath and basal parts of the legs as well as the face beneath the antennae with white hairs. . . . . *gravida*.
30. (27) If appressed hair-bands fill the apical impressions of the 2nd and 3rd segments, either the 2nd segment is pubescent or the puncturation is not as dense as possible.
31. (32) Abdomen more or less marked or banded with red or yellow; basal abdominal segment polished, remotely but distinctly punctured on the disc; scopal fringe above the tibiae and appressed hairs of 5th abdominal segment dark. . . . . *florea*.
32. (31) If the abdomen is marked with red or yellow either the basal abdominal segment is not polished or the anal fringe is golden.
33. (42) The abdomen has broad pubescent apical bands on the segments, and the tibiae and their scopae are evidently abnormal; the former wide at the apex and therefore more clavate than usual (Pl. XII, f. 10), the scopal fringe above them dense and short in proportion to the apical width of the joint, while on its outer side the hairs are less dense and finer than usual and those that curve upwards from beneath less curved and conspicuous.  
(Floccus in most species distinctly, but in *fuscipes* hardly, imperfect.)

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\* It is important to notice that the bands are formed of hairs that spring from almost the whole surface of the apical impressions, as otherwise some *ovatula* might be confused with the species falling under the above head. When worn and abraded, *flavipes* and *gravida* remain easily distinguishable by the extremely dense and fine puncturation of the apical impressions considered in conjunction with the other characters given above. Not infrequently the bands are slightly interrupted in the middle in caught specimens, but this is not the natural condition.

34. (41) Mesonotum clothed with fulvous or bright brown hairs and without black ones.
35. (36) Face with black or sooty hairs; hind coxae and at least the basal part of the trochanters beneath with dark hairs. . . . . *nigriceps*.
36. (35) Face with much pale hair; that on the hind coxae beneath and the trochanters pale.
37. (40) Appressed hairs of 5th abdominal segment black or fuscous, not nearly concolorous with the apical pubescent band of the 4th segment.
38. (39) Under a strong lens the 3rd abdominal segment has a shallow but dense and distinct (often granulate) puncturation on most of its surface; floccus notably imperfect, many thick stiff white hairs on the basal part of the trochanter beneath. . . . . *simillima*.
39. (38) Under a strong lens the 3rd abdominal segment has a very feeble puncturation often appearing merely as minute granules, its apical hair-band entirely appressed (not formed partly of subdecumbent or suberect ones as in the preceding species); floccus pale ochreous, very dense and all but perfect. . . . . *fuscipes*.
40. (37) Appressed hairs of 5th abdominal segment quite pale and concolorous (or almost so) with the preceding hair-band; scopae pale brownish, or yellow. . . . . *tridentata*.
41. (34) Mesonotum and often the scutellum clothed to a considerable extent with black hairs. . . . . *denticulata*.
42. (33)\* Hind tibiae not abnormal as described under 33; many of the species are without wide and distinct hair-bands.
43. (44) Basal abdominal segment strongly and densely punctured, shining between the punctures, and with a clothing of long thin pubescence; 2nd, 3rd, and 4th segments with dense pale narrow streaks on the apical margins, forming a conspicuous pattern. . . . . *labialis*.  
(A large species with smoky wings, hind tibiae dark scopal fringe above them yellow or sometimes nearly white; appressed hairs of 5th abdominal segment fuscous or sordid, often with underlying paler hairs.)
44. (43) Species without the above combination of characters.
45. (46) Appressed hairs of 5th abdominal segment quite pale, yellow or golden, without admixture of dark fuscous or sordid hairs.

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\* Perhaps the nearest approach to the *nigriceps* group in this respect is to be found in *A. praecox*.

- 45a. (53) Scopa yellow or golden.
46. (47) Basal abdominal segment with distinctly granulate puncturation, the punctures (or many of them) set in small tubercles or granules; hind tibiae dark beneath the scopae. . . . . *humilis*.
47. (46) Basal segment usually with ordinary punctures; if these are inclined to be granulate the hind tibiae are clear yellow beneath their scopae.
- 47a. (48) A very large species with dark wings, the basal segment with sparse and very remote punctures. . . . *hattorfiana*.  
(Abdomen either black or more or less red.)
48. (47a) Small or medium-sized species, or, if rather large, the basal abdominal segment has a dense and almost even puncturation.
49. (52) Hind tibiae and tarsi entirely or almost entirely clear yellow.
50. (51) Mesonotum and scutellum finely rugose all over under a strong lens and dull in consequence. . . . *chrysoseles*.  
(Intermediate abdominal segments with dense white apical streaks.)
51. (50) Mesonotum and scutellum conspicuously shining between the punctures. . . . . *fulvago*  
(Scopal fringe above the tibiae extraordinarily long.)
52. (49) Hind tibiae dark beneath the scopae. . . . . *polita*.
53. (45a) Scopa forming a dark or sooty-grey fringe above the tibiae when these are viewed on the inner surface.  
*marginata*.  
(Abdominal colour very variable, from nearly all black to nearly all yellow through banded forms.)
54. (45) Appressed hairs of 5th abdominal segment not all pale yellow or golden, often dark, sometimes fuscous with golden or reddish tinge in part, or the segment has some yellow and some dark hairs.
55. (56) A small species with red 2nd and 3rd segments of the abdomen, the 1st and 2nd very distinctly and densely (for the most part evenly) punctured all over. *cingulata*.
56. (55) Species quite unlike the preceding.
57. (76) Scopa forming a yellow or golden fringe above the tibiae when these are viewed inwardly, seen with the naked eye the scopa appears conspicuously red, yellow or golden. Hind tibiae in some of the species clear translucent red or yellow.
58. (59) Whole abdomen very densely clothed with long pubescence (either all black or partly or even almost wholly pale)

- hairs of face black, the floccus sooty or sordid; hind tibiae pale. . . . . *clarkella*.
59. (58) Abdomen seldom densely clothed, and then not as in *clarkella*; the floccus is pale.
60. (67) Fifth antennal joint distinctly elongate, not square in outline, still less transverse.
61. (62) Hind tibiae clear translucent yellow. . . . . *ferox*.
62. (61) Hind tibiae dark beneath the hairs.
63. (64) Floccus very imperfect, small and thin; even in the finest examples the whole disc of the basal abdominal segment is hairless or nearly so, having at most a few fine and long hairs. . . . . *bucephala*.
64. (63) Floccus quite perfect, long curved hairs occupying the whole trochanter; in fresh specimens the basal segment is clothed all over rather thinly with long hairs or is densely clothed apically and with thinner long hairs more basally.
65. (66) Clypeus except for a smooth median line with rather even and close, distinct punctures; minute surface sculpture of basal abdominal segment not extraordinarily dense under a strong lens, so that at the sides it generally appears rather shining, and to the naked eye the whole abdomen appears somewhat shining and for a large part bare. . . . . *fuscata* var.
66. (65) Clypeus with a wide median space of irregular puncturation, the punctures themselves often vague in outline; minute surface sculpture of the very dull basal segment extremely dense; abdomen dull and pubescent to the naked eye. . . . . *helvola*.
67. (60) Fifth antennal joint, viewed beneath (or in front) generally wider than long, at most so long as to appear about square in outline.
68. (69) Hind tibiae clear translucent yellow and nearly concolorous with the scopal fringe above.
- 68a. (68b) Abdomen nearly glabrous above, basal segment without a definite apical impression. . . . . *ruficrus*.
- 68b. (68a) Abdomen with longish pubescence, in fresh specimens forming distinct apical bands on the segments; basal segment with a distinct apical impression. *angustior* var.
69. (68) Hind tibiae dark beneath the scopal fringe.
70. (75) Rather small or medium-sized species with the basal segment widely rugulose along the apical margin and on this part (at least on the middle of the segment) almost impunctate.

71. (72) If the insect be viewed from beneath parts of the sides of the thorax have more or less black hairs; the hairs on part of the hind trochanter more or less (and often those on the coxae and the curled ones of the floccus) black or at least sordid; facial hairs often black.  
*gwynana* and var. *bicolor*.
72. (71) Sides of thorax and trochanters with pale hairs only; floccus pale.
73. (74) Clypeus with a faint longitudinal median impressed line on its basal part, quite noticeable in some aspects.  
*angustior*.
74. (73) Clypeus without an impressed line, sometimes with a slight smooth one, not impressed.  
*gwynana* var. *bicolor* ab.
75. (70) A large species, the puncturation of the basal abdominal segment is distinct on the apical portion, and though the punctures are finer and less numerous than more basally they come rather near to the apical margin itself. . . . . *nigroaenea*.
76. (57) Scopae not forming a distinctly yellow or golden fringe above the tibiae, often dark, more rarely greyish (from a mixture of pale and dark hairs) or nearly white and viewed in the natural position from above with the naked eye not conspicuously golden, yellow, or red. Hind tibiae never translucent red or yellow in any species.
77. (86) Large species, the abdomen nearly wholly shining and glabrous above to the naked eye (except that in one species some of the segments bear in parts some white tomentum in fresh examples), the apices of the segments never with apical bands or lateral streaks of dense short white hairs, forming a distinct pattern.
78. (83) Thorax with bright brown or fulvous hairs.
79. (80) Under parts of thorax and whole of the scopae with black hairs, basal abdominal segment finely and not very closely punctured. . . . . *thoracica*.
80. (79) Under parts of thorax and the scopae beneath with white or almost white hairs; basal segment very densely punctured, the 2nd and 3rd with some dense white tomentum or short hairs visible at least at the sides except in much-worn examples.
81. (82) Face beneath the antennae with pale hairs. . . *nitida*.
82. (81) Face beneath the antennae with black or dark fuscous hairs. . . . . *nitida* var. *baltica*.

83. (78) Thorax clothed with whitish, or with white and black hairs.
84. (85) Thorax clothed with whitish hairs all over. . . . *vaga*.
85. (84) Thorax with a transverse band of black hairs. . . . *cineraria*.
86. (77) If the abdomen is glabrous and shining, it has a distinct pattern formed by narrow apical bands or lateral streaks of dense pale hairs on the intermediate segments.
87. (88) Anterior area of propodeum well exposed on its dorsal face (owing to the paucity of hairs surrounding it) rather strongly and evenly rugose all over, the rugosities dense and sinuous or reticulate; 2nd segment practically glabrous and distinctly rugulose under a strong lens (excepting generally the apical impression) and with very few and feeble punctures. . . . *proxima*.
88. (87) View of propodeal area often interfered with by dense hairs about it; in many the first two segments of the abdomen are conspicuously hairy, in others the 2nd segment is not distinctly rugulose or the sculpture of the propodeal area is quite different.
89. (95) Basal abdominal segment polished; 5th antennal joint very short (viewed from in front or beneath) transverse or subtransverse.  
(The intermediate abdominal segments always have narrow apical bands or lateral streaks of white or almost white hairs, forming a pattern.)
90. (91) First two segments of abdomen with a general (but thin) clothing of longish pale hairs. . . . *sericea*.  
(Second segment with the punctures nearly effaced, these being remote and extremely minute.)
91. (90) First two segments without a general clothing of long hairs.
92. (93) Thorax well clothed with yellowish brown or fulvescent hairs; the view of the anterior area of the propodeum interfered with by the surrounding hairs. . . . *argentata*.  
(Flocus large, perfectly developed on the whole trochanter.)
93. (92) Thorax sparsely hairy above, the dorsal surface of the propodeum well exposed, bearing only scanty pubescence; flocus either small or imperfectly formed.
94. (94a) Scutellum densely punctate round the margins at least and generally shining on the disc; scopa with many fuscous hairs, white or silvery beneath. . . . *coitana*.
- 94a. (94) Scutellum flatter, rugulose over its whole surface and very sparsely punctured; scopa almost white throughout. . . . *nitidiuscula*.

95. (89) Basal abdominal segment not polished, but with fine rugulose sculpture under a strong lens, so that the surface is opaque or subopaque; 5th antennal joint generally distinctly elongate, very rarely appearing about square in outline and never very short.
96. (110) Floccus large and absolutely perfect.
- 96a. (97) Scopae entirely black as also the curved hairs at the sides of the propodeum. Abdomen very densely clothed with beautiful fulvous hairs which in fresh examples are of a paler colour than those of the thorax. . *fulva*.
97. (96a) Scopae always pale beneath.
98. (99) Apical impressions of 3rd and 4th abdominal segments abnormal, only defined at the sides and widely obliterated in the middle, but their position can be distinguished (best when the insect is viewed from behind with its head downwards) by a row of fine piliferous punctures, and they are then seen to be extraordinarily wide in this part, occupying nearly the whole segments if these are moderately extended, or the whole if they are at all strongly contracted.
- (Punctures of clypeus for the most part sparse or irregular, and often with ill-defined outlines; colour of abdominal pubescence variable, the two basal segments with fulvous hairs, the two following sometimes both with dark or both with pale (whitish or partly fulvous and partly white) pubescence). . . . . *synadelpha*.
99. (98) Apical impressions of 3rd and 4th segments often feeble and sometimes narrowly obliterated in the middle; but their position is still discernible in some aspects, when they are seen to be not of extraordinary width. In some species they are quite distinct throughout, though shallow.
100. (103) Hairs on the middle and hind coxae more or less sordid in colour, not clear white nor pale ochreous (face often, but not always, with black or sooty hairs).
101. (102) First and 2nd segments of the abdomen very densely haired in part, the surface on the basal middle part of the 2nd hidden by the dense covering, unless the specimen is abraded. The abdomen dull, from the close, minute sculpture and dense pubescence.
- varians*.
102. (101) First and 2nd segments with a thin clothing of long fine hairs, abdomen distinctly shining to the naked eye.
- lapponica*.

103. (100) Hairs of the middle and hind coxae not sordid, but white or pale ochreous.
104. (105) First and 2nd abdominal segments thinly clothed with long fine hairs, the following appearing nearly bare to the naked eye and the abdomen shining. *fucata*.
105. (104) Abdomen copiously hairy.
106. (107) Hairs which spring from the punctures of the 5th segment (in front of the decumbent apical fringe) pale.  
*praecox*.
107. (106) Hairs of the 5th segment (except sometimes at the sides) dark, rarely with one or two pale hairs amongst them.
108. (109) Thorax with ochreous or brownish-ochreous hairs, a large species, rather resembling the common *A. trimmerana* Auct.; hairs of coxae beneath and floccus pale brownish yellow or ochreous, 4th and 5th segments not densely clothed with decumbent white or almost white hairs. . . . . *apicata*.
109. (108) Thorax in fresh examples with dense bright brown or fulvous hairs, hairs of coxae and floccus white; sides of 2nd, the 3rd and 4th abdominal segments, densely clothed with more or less decumbent white or pale hairs. . . . . *varians* var. *mixta*.
110. (96) Scopae small and very imperfect.
111. (114) Thorax above for the most part bare or very little hairy, though well clothed in front and behind and at the sides, the abdomen also largely glabrous above.  
(Abdomen generally more or less marked with red or yellow.)
112. (113) Hairs of face about the antennae and below these mostly yellowish brown or ochreous. . . . . *rosae*.
113. (112) Hairs of face darker, generally much mixed with blackish or sooty brown. . . . *eximia* (= *rosae* spring brood).
114. (111) Thorax above well clothed with pubescence, as also is the abdomen.
115. (118) Abdomen more or less marked with red or yellow either above or beneath on the 1st or 2nd segment or on both; scopae with yellow hairs beneath, not silvery white ones.
116. (117) Face either entirely clothed with black hairs or more commonly with a few brown or yellow ones about the insertion of the antennae.  
*spinigera*=*trimmerana* K. (nec Auct. caet.) 1st brood.

117. (116) Face with many pale hairs especially in the antennal region. . . . . *trimmerana* K. 2nd brood.
118. (115) Abdomen black, at most with the apices of some of the segments a little discoloured or pallid; scopae generally silvery white beneath.
119. (120) Face more or less considerably clothed with pale hairs; the pale hairs of the abdomen not confined to the first two segments. . . . . *trimmerana* Auct. nec Kirby.
120. (119) Face entirely or almost entirely clothed with black or blackish fuscous hairs; abdomen behind the 2nd segment clothed with black hair.  
*trimmerana* Auct. var. *scotica*.

TABLE OF ♂ NOMADA.

1. (2) Labrum black, the mandibles bidentate at apex.  
*fabriciana*.  
(Abdomen normally with two pairs of small lateral yellow spots.)
2. (1) If the labrum is black the mandibles are simple at the apex.
3. (6) Abdomen without any yellow or white markings, labrum black.  
(Medium-sized or rather small species with short antennae, many of the flagellar joints produced into a minute tubercle behind; abdomen, especially towards the sides, with silvery pubescence, very noticeable in some aspects.)
4. (5) Hind femora beneath for the greater part dull and densely punctured and pubescent. . . . . *germanica*.  
(Flagellum of antennae pale beneath.)
5. (4) Hind femora beneath for the most part polished and glabrous, very little punctured except at the extreme base. . . . . *atrata*.  
(Flagellum dark or infuscate beneath.)
6. (3) Abdomen with at least small lateral yellow spots on one or more of the basal segments, often conspicuously spotted or banded.
7. (8) Species large (8·5–11 mm. long) labrum black, armed with a strong median triangular tooth anteriorly, 3rd antennal joint beneath as long as the 4th. . . . . *armata*.  
(Front femora dilated, the basal half or more in front occupied by a great ovate impression; hind femora at the extreme base beneath clothed posteriorly with long curved hairs, much longer than those on the trochanter; adjoining this, with an area very densely clothed

with more decumbent hairs; flagellum of antennae fulvous, its second joint with a black stripe behind.)

8. (7) If the labrum is black the species are small or medium-sized, 7.5 mm. or less.
9. (12) Scape black in front (as well as behind) the 3rd antennal joint beneath as long or longer than the 5th.
10. (11) Labrum pale (yellow or dull red) the hind femora beneath very densely finely punctured and clothed with dense short hairs. . . . . *guttulata*.  
(Yellow spots of 2nd and 3rd abdominal segments small and lateral, sometimes each of them divided into two; front and middle femora beneath with well-developed moderately long fringe.)
11. (10) Labrum wholly or partly black, the hind femora beneath polished, almost bare, and very sparsely punctured. . . . . *obtusifrons*.  
(A small species 7.5 mm. or less, the 3rd antennal joint beneath slightly but distinctly longer than the 4th or 5th, which are hardly longer than broad; face not compressed into a sharp carina between the antennae, but sometimes with a raised median line there; middle femora with a distinct hair fringe beneath; labrum sometimes pale on the basal half.)
12. (9) Scape in most species more or less pale in front; if black the 3rd antennal joint on its lower side is shorter than the 5th.
13. (14) Scutellum with a single bright yellow marking; 2nd abdominal segment with well-separated yellow spots, which do not form a band. . . . . *rufipes*.  
(Front femora with a thin fringe beneath, that on the middle ones hardly noticeable, hind ones much as in *obtusifrons*.)
14. (13) Scutellum with a single bright yellow spot only in one species, which has an entire (or almost entire) yellow band on the 2nd segment of the abdomen.
15. (16) A single (or indistinctly divided) red or orange-red spot on the scutellum; 3rd antennal joint beneath subequal to the 4th. . . . . *tormentillae*.  
(Scape of antennae yellow in front; propodeum only with short inconspicuous hairs on each side; middle and hind femora without a fringe beneath; spots of 2nd abdominal segment separated by a distance about equal to the length of one of these or by a greater distance.)

16. (15) Scutellum rarely with a single red marking (often with 2 red or yellow spots or all black) if with a single large red marking the 3rd antennal joint beneath is much shorter than the 4th.
17. (18) A somewhat robust black and yellow (bicoloured) species, with the apical margin of hind tibiae without distinct spines or fringe. . . . . *flavopicta*.  
(Labrum and front of scape yellow or pale, the antennae practically all black above; thorax clothed only with very short hairs and with two large round yellow spots on the scutellum; front and middle femora without a fringe beneath; yellow spots on each side of 2nd and 3rd segments of abdomen widely separated.)
18. (17) Apical margin of hind tibiae above with spines or conspicuous fringe or both; many species have tricoloured abdomen.
19. (20) A large robust bicoloured species, the 3rd antennal joint viewed from beneath (or in front) as long as the 4th.  
*6-fasciata*.  
(Cheeks longer than in any other species, the face produced anteriorly; hind tarsi unusually thick, the 2nd joint seen on the outer side not much longer than wide, front and middle femora with long fringe beneath, the apical margin of hind tibiae with well-developed fringe; yellow spots of 2nd abdominal segment wedge-shaped and well separated; flagellar joints of the antennae shining beneath and in some aspects showing a narrow pale pubescent band at the base.)
20. (19) Such species as are bicolorous have the 3rd antennal joint distinctly shorter than the 4th, when viewed from in front or beneath.
21. (24) Hind femora at the extreme base beneath with a highly specialised area clothed with extremely dense and short hairs and entirely different from the rest of the surface, the trochanters with a dense fringe or tuft of longer hairs.
22. (23) Basal abdominal segment bicoloured, the basal joints of the flagellum of antennae posteriorly black-marked.  
*goodeniana*.
23. (22) Basal abdominal segment tricoloured, basal and apical joints of flagellum pale behind, some of the intermediate ones with black markings. . . . . *fucata*.
24. (21) Hind femora and trochanters not thus clothed.
25. (26) The flagellar joints of the antennae seen with a strong lens

- have small but conspicuous tubercles behind, projecting like small thorns. . . . . *lathburiana*.
- (A tricoloured species of good size, the middle femora without a distinct fringe beneath, the hind ones shining beneath, copiously punctate, the punctures irregular in size; 3rd joint of antennae seen from beneath as long as the 4th.)
26. (25) Antennae not conspicuously tuberculate.
27. (30) Abdomen black and yellow, bicoloured to the naked eye, the scape of the antennae pale in front or with pale area.
28. (29) Third antennal joint viewed from in front very short on the lower side, its length there being shorter than the same side of the 5th joint. . . . . *lineola*.
29. (28) Third antennal joint, viewed as above, with the lower side about equal to that of the 5th. . . . . *marshamella*.
- (These two species vary in important characters, but the shape of the apical margin of the hind tibiae seen dorsally from the base is different. Most examples have a different facies from the fact that the yellow spots of the 2nd abdominal segment of *marshamella* are usually blunt or truncate on their inner extremity. The colour of the tegulae and prothoracic tubercles vary, in some examples the relative length of the antennal joints does not greatly differ in these species.)
30. (27) Abdomen definitely brown or ferruginous in part or the scape is black in front.
31. (32) Mandibles distinctly bifid at the apex. . . . . *bifida*.  
(Species of the same size and resembling in general coloration some varieties of *ruficornis*, *flava* and *signata*.)
32. (31) Mandibles not bifid.
- 32a. (57) Third joint of antennae viewed from in front much shorter than the 4th; species seldom excessively small.
33. (56) Labrum pale at least to a considerable extent.
34. (43) Scape of antennae black in front as well as behind (or above).
35. (40) Scutellum black, not marked with red.
36. (37) Tubercles of pronotum black with a sulphur yellow hind margin. . . . . *xanthosticta*.
37. (36) Tubercles not as above.
38. (39) Third, 4th and 5th abdominal segments with conspicuous yellow bands, not or only slightly interrupted in the middle; species not very small. . . . . *leucophthalma*.
39. (38) Third, 4th and 5th segments without conspicuous bands; species small. . . . . *flavoguttata* ab.

40. (35) Scutellum with red spots or red marking.
41. (42) Yellow markings of 2nd and 3rd abdominal segments sometimes forming complete bands and never both interrupted for a space equal to one-third the width of the segment. . . . . *ruficornis*, ab.  
(Fringe beneath middle femora long; mandibles pointed at apex.)
42. (41) Yellow markings on each side of 2nd and 3rd segments well separated from one another by a distance equal to about one-third the width of the segment viewed dorsally or still more widely than this. . . . *hillana*.  
(Fringe beneath the middle femora short, not very different from that beneath the hind ones; mandibles in some aspects truncate at apex.)
43. (34) Scape pale beneath (or in front) or at least with a considerable pale area.
44. (55) Middle femora with a distinct fringe beneath.
45. (48) Front tibiae without a black or dark fuscous marking on their outer (or posterior) surface.
46. (47) The whole clypeus and front of the scape of the antennae cream-coloured, mandibles pointed at the tips. *baccata*.
47. (46) The whole of the clypeus and of the front of the scape not cream-coloured; mandibles truncate at apex in some aspects. . . . . *hillana* var. *ochrostoma*.
48. (45) Front tibiae with a dark marking posteriorly.
49. (50) Spots of 2nd abdominal segment well separated, by a space generally about one-third to one-fifth the width of its base, spots of 3rd segment more widely separated than these, and blunt or truncate inwardly; fringe beneath the middle femora short and dense and quite unlike that on the front ones. . . . . *bucephalae*.  
(Antennae unusually long and slender; the scutellum without red spots.)
50. (49) Abdominal pattern or segment 1 and 2 rarely resembling the above, if approaching it, then the middle femora have a long fringe beneath not differing greatly from the front ones in this respect.
51. (52) Abdominal bands on segments 2-5 all entire; the yellow apical band on the face not continued back as an orbital line nearly as far as the insertion of the antennae. *signata*.
52. (57) If the abdominal bands on segments 2-5 are all entire then the yellow facial marking is continued back along the orbits as far as the line of the insertion of the antennae.

(N.B.—The band of the 2nd segment at least is usually divided in the middle by a thin streak or else indented above by a wedge of ground-colour, and some of these varieties resemble *signata* in lacking the long yellow orbital lines. The 2nd abdominal band of *signata* is not thus slightly divided or partially divided.)

53. (54)\* Wings light shining fuscous, appearing distinctly flavescent; fringe of middle femora beneath usually decidedly shorter. . . . . *flava*.
54. (53) Wings more greyish; fringe of middle femora beneath generally longer. . . . . *ruficornis*.
55. (44) Middle femora beneath with the hairs so extremely short that a fringe is hardly perceptible, the front femora are similar, but a few longer hairs may be observed.

*conjungens*.

(Antennae very long and slender, the 3rd joint viewed from in front extremely short; where shortest, not half the length of the very elongate 4th, which appears twice, or more than twice, as long as wide.)

56. (33) Labrum black. . . . . *flavoguttata*.  
(Antennae like those of *conjungens*, but the fringe beneath the middle femora though short is sufficiently distinct; the abdominal spots are usually considerably less developed and the average size is much less.)
57. (32a) Third antennal joint viewed from beneath subequal to the 4th; an extremely small species. . . . . *furva*.

TABLE OF ♀ NOMADA.

1. (2) Labrum black, the mandibles bidentate at the apex.  
*fabriciana*.  
(Second and 3rd abdominal segments with a small yellow spot on each side, one or both pairs of which may be wanting; antennae, except in rare aberrations, distinctive, the extreme base of flagellum black, following joints pale as also the apical one, the joints between these black.)
2. (1) If the labrum is black the mandibles are simple.
3. (6) Abdomen with no yellow spots or markings; the propodeum is copiously pubescent right up to the margins of the anterior area, the pubescence not forming a restricted patch or tuft.

\* Owing to the great variation in the colour and development of both species I cannot give more satisfactory characters.

(Labrum black, the mesonotum without red lines, though the scutellum has red spots or marking.)

4. (5) Hind femora ferruginous above, the flagellum of antennae pale beneath. . . . . *germanica*.

5. (4) Hind femora nearly entirely black, flagellum mostly dark beneath. . . . . *argentata*.

(Propodeum very densely and conspicuously clothed with silver hairs outside the area.)

6. (3) Abdomen rarely without either yellow spots or bands, and if so, the propodeum is bare along the margins of the area, the pubescence forming a patch or tuft on each side.

7. (8) A large species 8.5–11 mm., labrum black with a strong triangular tooth in the middle towards the apex.

*armata*.

(Spots of 2nd abdominal segment lateral, apical margin of hind tibiae with a close series of strong black spines; sides of propodeum with dense silver pubescence outside the area.)

8. (7) When the labrum is black the species are less than 8 mm. long.

9. (10) Apical margin of hind tibiae with 2–4 excessively short, approximated, black spines, which often appear at first sight as a small black spot on the margin.

*guttulata*.

(Yellow spots of 2nd abdominal segment small and lateral, the 5th with a pair of triangular ones sometimes approximated basally; scape of antennae black beneath, labrum pale, propodeum with conspicuous tuft of silver pubescence on each side; species small or rather small.)

10. (9) Apical margin of hind tibiae never armed as in *guttulata*.

11. (12) Labrum and scape\* both black or pitchy black and the 4th antennal joint seen from in front is only a little longer than wide . . . . . *obtusifrons*.

(A small species, the spots of the 2nd abdominal segment widely separated, propodeum only with short inconspicuous pubescence; face between the antennae not compressed into a sharp median carina.)

12. (11) If the labrum and scape beneath are both black, the 4th antennal joint is about twice as long as wide; in most species the labrum is pale.

13. (18) Mesopleura and propodeum outside the area with at

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\* The extreme base of the scape is sometimes red.

most a short inconspicuous pubescence, sometimes nearly bare; mesonotum never with red markings, scape of antennae pale beneath, the flagellar joints dark at least on one side.

14. (15) Scutellum with a red or ferruginous spot. *tormentillae*.  
(Cream-coloured spots of 2nd abdominal segment widely separated; apical margin of hind tibiae with very short spines.)
15. (14) Scutellum with sulphur yellow spot or spots.
16. (17) Scutellum with a single transverse yellow spot. *rufipes*.  
(Antennae short, mesopleura almost always with a conspicuous yellow marking, apical margin of hind tibiae with short pointed spines; abdomen very variable in colour, bicoloured or tricoloured.)
17. (16) Scutellum with two round yellow spots. *flavopicta*.  
(Abdomen black with yellow markings, the first segment with a yellow band nearly always slightly interrupted in the middle, second with wedge-shaped spots; apical margin of hind tibiae without spines.)
18. (13) Propodeum outside the area and the mesopleura, or one of those parts usually with more or less long pubescence or hairs; mesonotum in many species with red markings, scape in some black beneath, flagellum of antennae sometimes entirely pale.
19. (20) Face strongly produced anteriorly, so as to be subrostrate. *fasciata*.  
(A large, robust, bicoloured species, 1st, 2nd, and 3rd abdominal segments with elongate spots on each side, the pronotum black above; apical margin of hind tibiae with a dense fringe of hairs, with the spines not easily distinguishable amongst these.)
20. (19) Face normal.
21. (24) Hind tibiae with the apical margin peculiarly armed, having the usual apical process or projection and outwardly from this with two or three short stout spines (often so closely apposed as to appear like a single projection) inclined or bent towards the apical process.
22. (23) Abdomen tricoloured, the scutellum with a median yellow spot. *fucata*.
23. (22) Abdomen bicoloured, the scutellum with a pair of spots, rarely wanting. *goodeniana*.
24. (21) Armature of hind tibiae otherwise.
25. (56) Labrum pale, at least to a considerable extent; species not excessively minute and without flavous abdominal spots.

26. (27) Third antennal joint seen from beneath distinctly (though not greatly) longer than the 4th. . . . *lathburiana*.  
(Scutellum with two yellow spots sometimes suffused with orange; mesonotum with dense erect reddish hair in fresh examples, abdomen tricoloured.)
27. (26) Third antennal joint beneath at most equal to the 4th, often rather shorter.
28. (31) Abdomen black and yellow not definitely tricoloured, the mesonotum without red lines or markings.
29. (30) Apical marking of face not continued up along the margins of the eyes to the height of the antennae; flagellum of antennae unicolorous, not distinctly dark or infuscated on any of the joints in front. . . . *marshamella*.
30. (29) Apical markings continued along the eye-margins up to the line of the antennal insertions, or else the more apical flagellar joints at least are darkened in front.  
*lineola*.
31. (28) Abdomen obviously brown or ferruginous in part (tricoloured).
32. (33) Pronotum above with yellow band or spots and its tubercles also bright yellow; mesonotum without red markings, scutellum nearly always with a pair of yellow spots. . . . *lineola* var.
33. (32) Pronotum often red-marked or else black, not yellow-marked.
34. (35) Mandibles bifid at the apex. . . . *bifida*.  
(Apex of hind tibiae with elongate very fine spines of nearly equal length amongst the hair fringe; dense rather long white hairs on either side of the anterior area of propodeum; black ocellar area generally entirely surrounded by red.)
35. (34) Mandibles not bifid.
36. (37) Apical margin of hind tibiae armed with several (normally 5) very long, conspicuous black spines, not differing much from one another. . . . *baccata*.  
(Abdominal markings cream-coloured; propodeum red with a median black stripe and densely silvery-haired outside the area; greater part of mesonotum red.)
37. (36) Apical margin of hind tibiae otherwise armed.
38. (39) Mandibles truncate \* at apex. . . . *hillana*.  
(Spots of 2nd abdominal segment lateral, very widely separated, apex of hind tibiae with the innermost of

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\* This character can only be seen clearly in certain aspects.

- the series of spines slender and elongate, the outer ones much shorter and stouter.)
39. (38) Mandibles not truncate at apex.
40. (45) Mesonotum black, without red lines or markings.
41. (42) Prothoracic tubercles bright yellow. . . . *xanthosticta*.  
(Spots of 2nd abdominal segment lateral, the two together in dorsal aspect not usually as long as the distance between them; they are said to be very rarely obsolete.)
42. (41) Prothoracic tubercles not bright yellow.
43. (44) Mesonotum with a general clothing of longish erect pubescence similar to that on the front of the head.  
*leucophthalma*.  
(Spots of 2nd segment rarely separated by a distance greater than the length of one of them and often by less.)
44. (43) Mesonotum with short and scanty pubescence.  
*ruficornis* ab.
45. (40) Mesonotum with red lines or markings.
46. (55) Spots of 2nd abdominal segment not minute, together in dorsal aspect they are usually at least as long as one-third the width of the segment, or the segment may have a complete band.
47. (48) Mesonotum clothed with longish erect pubescence like that on the front of the head. . . . *leucophthalma* var.
48. (47) Mesonotum with short and scanty hair except at the extreme front.
49. (50) Spots of 2nd abdominal segment lateral, the distance between them greater than the length of one of them in dorsal aspect; antennae unusually long and slender, the flagellar joints behind with a thin fringe of erect hairs, quite distinct. . . . . *bucephalae*.
50. (49) Colour of 2nd segment very variable, often with entire or almost entire band; if with remote spots as in *bucephalae*, the antennae are shorter and their fringe is very sparse or indistinct.
51. (52) Second and following segments with entire broad yellow bands, that on the 2nd not notably excised in the middle of its upper margin; area of black on the posterior two-thirds of mesonotum greater than that of red colour. . . . . *signata*.  
(Propodeum usually with a large trilobed yellow spot.)
52. (51) Second and following segments rarely all with wide complete bands as in *signata*, and if so, the posterior two-thirds of the mesonotum is more red than black.
53. (54) Wings light shining fuscous, yellow-tinged, flagellum

- unicolorous, fulvous in front and behind; minute hairs on propodeum and on the hind coxae flavescent. *flava*.
54. (53) Wings more grey, the flagellum usually with at least one or two of the more apical joints infuscated in front; minute hairs of propodeum and coxae silvery white.  
*ruficornis*.
55. (46) Spots of 2nd segment minute, together in dorsal aspect not occupying one-third of the width of the segment, sometimes they are wanting. . . . *flavoguttata* ab.  
(Labrum red, the propodeum with a tuft or patch of silvery hair on each side above the insertion of the abdomen.)
56. (25) Labrum black, or the species is very minute and without distinct flavous abdominal markings.
57. (60) Labrum black, 3rd antennal joint beneath shorter than the 4th.
58. (59) Propodeum with a conspicuous patch or tuft of silvery hair on each side posteriorly; large red marking of the mesopleura approaching near the red spot beneath the insertion of the wings, or coalescing with this.  
*flavoguttata*.
59. (58) Propodeum often entirely without a tuft of hair or with this comparatively less developed; the red mesopleural spot beneath the wings is widely separated from the longitudinal red line or band beneath it. . *conjungens*.  
(This species is very closely allied to *flavoguttata*, but is of larger average size and has the yellow abdominal spot<sup>t</sup> larger in normal examples.)
60. (57) Labrum red, the 3rd antennal joint not shorter beneath than the 4th. . . . . *furva*.  
(A very minute species, the abdomen without definite flavous spots and with a dense and conspicuous tuft of silvery hair on each side of the propodeum.)

The three species *obtusifrons*, *tormentillae* (*roberjeotiana* Sm. Saund.) and *rufipes* form a quite distinct group, the ♂ genital armature and 8th ventral segment being very different from those of any other. I should consider *flavopicta* as somewhat allied to the latter, but the alliance is very remote.

*N. germanica* and *atrata* are allied to one another, but not close to any other species; *armata* and *guttulata* are both isolated, and I do not think the latter is really at all closely allied to *hillana*. The large species *N. sexfasciata* parasitic on *Eucera* has no close ally in this country, nor

has *lathburiana*. *N. fucata* and *goodeniana* are members of a natural group; but it contains no other British species.

Most of our species belong to the *ruficornis* group, containing besides *ruficornis* itself, *flava*, *signata*, *leucophthalma xanthosticta bucephalae* and *hillana*, and, at any rate in dealing with our small fauna, I should also include in it the following: *lineola* and *marshamella*, *baccata*, *bifida*, *conjungens*, *flavoguttata* and *fabriciana*. *N. furva* is an isolated form.

A series of examples of *N. marshamella* ♀ belonging to the second generation and taken at the burrows of the summer brood of *Andrena spinigera* is interesting in having the propodeum much less clothed than in specimens of the first brood. In some localities examples of the females of *N. lineola* have the flagellar joints of the antennae entirely fulvescent, none of these being darkened behind. I have not found this variety amongst numerous examples taken at the burrows of *Andrena bimaculata* and *carbonaria*, and suspect that it may only occur in those attached to *A. tibialis*, but it is possibly due rather to locality than host.

In conclusion I must express my thanks to my friends, the Rev. F. D. Morice and Mr. H. M. Hallett, to whom I am indebted for many valuable corrections and suggestions, which I have adopted in this paper, and who have put themselves to the great trouble (as I have previously mentioned) of looking into the validity of many of the specific characters, given in the tables of *Andrena*. I regret that I have been unable to make these more simple, but without disregarding variation, I do not see how this can be done.

So far as possible I have endeavoured to supplement the standard works of the late Edward Saunders by using characters which have previously been more or less overlooked or disregarded. I cannot sufficiently express how much I am indebted to our former leading authority on this group of insects not only for constant help by means of correspondence in the early days of my study, but also for the frequent loan of his whole series of difficult species, including the actual specimens, from which he drew up his descriptions.

## EXPLANATION OF PLATE XI.

*Andrena*, ♂, 3rd, 4th and 5th antennal joints.

- |                                |                            |
|--------------------------------|----------------------------|
| 1. <i>Andrena bimaculata</i> . | 11. <i>A. varians</i> .    |
| 2. <i>A. flavipes</i> .        | 12. <i>A. synadelpha</i> . |
| 3. <i>A. nigroaenea</i> .      | 13. <i>A. lapponica</i> .  |
| 4. <i>A. gwynana</i> .         | 14. <i>A. nigriceps</i> .  |
| 5. <i>A. florea</i> .          | 15. <i>A. sericea</i> .    |
| 6. <i>A. trimmerana</i> Auct.  | 16. <i>A. lucens</i> .     |
| 7. <i>A. ferox</i> .           | 17. <i>A. marginata</i> .  |
| 8. <i>A. bucephala</i> .       | 18. <i>A. dorsata</i> .    |
| 9. <i>A. clarkella</i> .       | 19. <i>A. minutula</i> .   |
| 10. <i>A. fulva</i> .          |                            |

## EXPLANATION OF PLATE XII.

1—9, 3rd, 4th and 5th antennal joints of ♀ *Andrena*.

- |                               |   |
|-------------------------------|---|
| 1. <i>A. bimaculata</i> .     | 9. <i>A. marginata</i> .                |
| 2. <i>A. florea</i> .         | 10. Hind tibia of <i>A. nigriceps</i> . |
| 3. <i>A. nigroaenea</i> .     | 11. " " <i>A. varians</i> .             |
| 4. <i>A. trimmerana</i> Auct. | 12. " " <i>A. tarsata</i> .             |
| 5. <i>A. varians</i> .        | 13. " " <i>A. coitana</i> .             |
| 6. <i>A. clarkella</i> .      | 14. " " <i>A. dorsata</i> .             |
| 7. <i>A. nigriceps</i> .      | 15. " " <i>A. similis</i> .             |
| 8. <i>A. hattorfiana</i> .    |   |

## EXPLANATION OF PLATE XIII.

Characters of ♂ *Andrena*.

1. *A. spinigera*, mandible.
2. *A. eximia* " "
3. *A. ferox* " "

4. *A. nigroaenea*, mandibles crossing at the tips.
5. *A. synadelpha*        "        "        "
6. *A. dorsata*, mandibles not crossing.
7. *A. praecox*, apex of 8th ventral segment.
8. *A. apicata*        "        "        "
9. *A. trimmerana*, Auct., cheek and base of mandible.
10. *A. lapponica*, base of mandible.
- 10a.        "        var. base of mandible.
11. *A. fulva*, base of mandible.
- 12, 12a. *A. praecox*, base of mandible.  
(12a very aberrant.)
- 13, 13a, 13b. *A. apicata*, base of mandible.  
(13a drawn from a Continental example.)
14. *A. fucata*, base of mandible.
15. *A. synadelpha*, base of mandible.

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EXPLANATION OF PLATE XIV.

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Antennal joints of *Nomada*.

1. *N. armata*, ♂, 3rd, 4th and 5th joints.
2. *N. sexfasciata*, ♂   "   "   "
3. *N. marshamella*, ♂   "   "   "
4. *N. lineola*, ♂       "   "   "
5. *N. lathburiana*, ♂   "   "   "
6.   "   "                3 flagellar joints showing tubercles.
7. *N. hillana*, ♂, 3rd, 4th and 5th joints.
8. *N. guttulata*, ♂     "   "   "
9. *N. flavoguttata*, ♂   "   "   "
10. *N. obtusifrons*, ♂   "   "   "
11. *N. ruficornis*, ♀    "   "   "
12. *N. lathburiana*, ♀   "   "   "
13. *N. lineola*, ♀     "   "   "
14. *N. marshamella*, ♀   "   "   "
15. *N. obtusifrons*, ♀   "   "   "
16. *N. flavoguttata*, ♀   "   "   "

